COMMONWEALTH OF VIRGINIA
DEPARTMENT OF EDUCATION

Superintendent of Public Instruction
Jo Lynne DeMary

Deputy Superintendent
M. Kenneth Magill

Assistant Superintendent for Instruction
Patricia I. Wright

Office of Secondary Instructional Services

Maureen B. Hijar
Director

Deborah Kiger Lyman
Mathematics Specialist

Table of Contents

Correlation of Activities to the 2001 Standards of Learning for Algebra

Equations and Inequalities

Activity	Related SOL	Page Number
Solving Equations in One Variable	A.1	1
Investigating Transformations	A.6	5
Match the Equation, Graph, and Table	A.7 & A.8	16
Equation of a Line from a Graph	A.8	21
Linear REAL Problems	A.5, A.8 & A.9	24
Discovery Lab	A.9	31
Exploring Equations	A.9	36
Solving Quadratics Graphically	A.14 & AII.8	38

Expressions and Operations

Activity	Related SOL	Page Number
Getting to Know Your Calculator; Measures of Central Tendencies	A.2 & A.17	43
Factoring	A.12	46
Estimating Square Roots	A.13	51

Introduction

The *Algebra Instructional Modules* are intended to assist classroom teachers of algebra in implementing the Virginia Standards of Learning for mathematics. These modules are organized into the five SOL Assessment Reporting Categories for Algebra I and Algebra II set out in the *Virginia Standards of Learning Assessment: Test Blueprints* from the Virginia Department of Education. Each activity in the modules is correlated to the appropriate Standards of Learning.

The purpose of these modules is to provide additional activities for teachers of Algebra I and Algebra II as they implement the use of graphing calculators and different approaches to SOL instruction into their classrooms. These activities are not intended to replace complete instruction of any SOL. The intent is for the activities to reinforce and enhance student understanding of concepts that have been taught as part of the local curriculum.

The use of technology, particularly the graphing calculator, is important in the instruction of the Standards of Learning. All of the activities in these modules are graphing calculator compatible. Keystroke information has not been included in these activities; it is assumed that students and teachers will have experience with the use of the calculator.

The activities were field tested in classrooms around the state in the spring of 1999 and in a 1999 summer workshop at the College of William & Mary. Virginia teachers are encouraged to modify and adapt the activities in the *Algebra Instructional Modules* to meet the needs of students in their classrooms. The activities in these modules may be duplicated as needed for use in Virginia.

The *Algebra Instructional Modules* are provided to school divisions through an appropriation from the General Assembly and in accordance with the Virginia Department of education's responsibility to develop and pilot model teacher, principal, and superintendent training activities geared to the Standards of Learning content and assessments, and to technology applications.

Acknowledgements:

The Department of Education wishes to express sincere appreciation to Jaynee Baird, Spotsylvania County, for the development of these activities, and to her students for trying them out. For participating in the piloting of these modules, appreciation goes to the

following school divisions: Carroll County, Dickinson County, Norfolk City, Portsmouth City, Powhatan County, and Smyth County.

Solve Equations in One Variable

Reporting Category: Equations and Inequalities
Related SOL: A.1

Background Information:

Virtually no experience with the graphing calculator is necessary.

Materials and Equipment:

- A teacher's hand
- Overhead projector
- Each student will need:
  Handouts

Notes to Teacher:

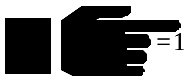
- This activity is intended to be an intuitive approach to solving equations in one variable.
- Although there are limitations as to the type of equation that may be used, this activity is quick and intuitive.
- Students are aided into deriving their "own" method to solve equations although the teacher cleverly guides the process.
- Discussion of inverse operations is apparent.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity will vary depending on the ability level of the students.

Solve Equations in One Variable Activity Sheet

First we must agree that the value of this equation is the same on the left as it is on the right.

Equation 1: $4 \bullet x = 12$

What is the value "under my hand"?

 $= 12$

Now what is the value "under my hand?"

$4 \bullet$  $= 12$

x=___________(Correct response: 3)

Equation 2: $x + 7 = 43$

What is the value "under my hand?"

 $= 43$

Now what is the value "under my hand?"

 $+ 7 = 43$

x=________ (Correct response: 36)

Equation 3: $x - 11 = 15$

What is the value "under my hand?"

 $= 15$

Now what is the value "under my hand?"

 $- 11 = 15$

x= ________ (Correct response: 26)

Equation 4: $\frac{x}{5} = 10$

What is the value "under my hand?"

 = 10

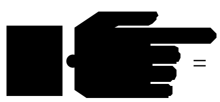
Now what is the value "under my hand?"

 = 10
5

x=___________

Equation 5: $4 \bullet x + 8 = 12$

What is the value "under my hand?"

 = 12

Now what is the value "under my hand?"

 + 8 = 12

Now what is the value "under my hand?"

4 •  + 8 = 12

x = _________________

Equation 6: $\frac{x}{5} - 1 = 4$

What is the value "under my hand?"

 = 4

Now what is the value "under my hand?"

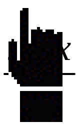
 - 1 = 4

Now what is the value "under my hand?"

$\frac{\quad}{5} - 1 = 4$

x=_____________

Equation7: $\frac{2 \bullet x}{3} + 7 = 13$

 + 7 = 13

$\frac{\quad}{3} + 7 = 13$

$\frac{2 \bullet}{3}$  + 7 = 13

x = ___________

Investigate Transformations, X-intercept,
Y-intercept, and Slope

Reporting Category: Equations and Inequalities
Related SOL: A.6

Background Information:

- Students will need to know how to identify a x-intercept and a y-intercept.
- Students will need to have been introduced to the idea of slope.
- Students will need to know how to enter information into the Y= function of the graphing calculator.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- In this activity students “discover” the significance of numbers in the equation of a line.
- Students will transfer this information when graphing more difficult curves.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Investigate transformations, x-intercept, y-intercept and slope

Goal: Students will graph linear equations of the form: Y = A(X ± B) when A ≠ 0 and B ≥ 0.

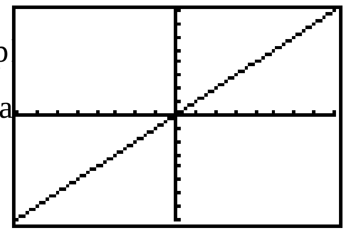
Note: This activity may be adapted to achieve the same goal by using only the general form Y= A(X + B), A ≠ 0, if "subtracting the value of B" is replaced with "add the opposite of B" to X.

Set up your calculator: <WINDOW> $[-8,8] by [-8,8]$

Your "BASIC" function will be $Y_1 = 1(X + 0)$

Examp

Critical Sta



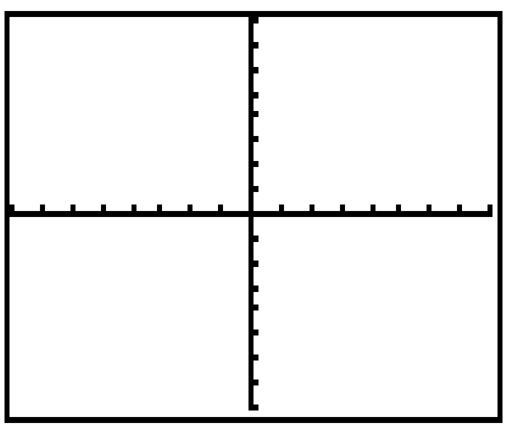
X- intercept = 0

Y-intercept = 0

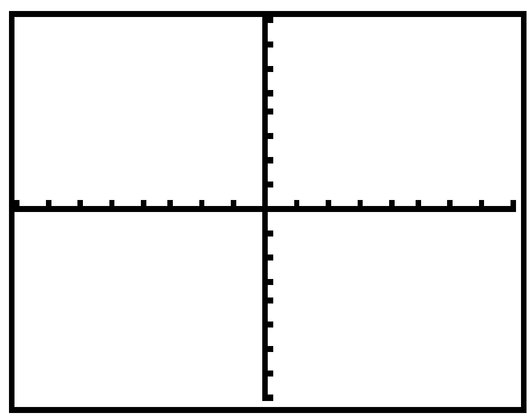
Slope = 1

Sketch a graph for each equation below:

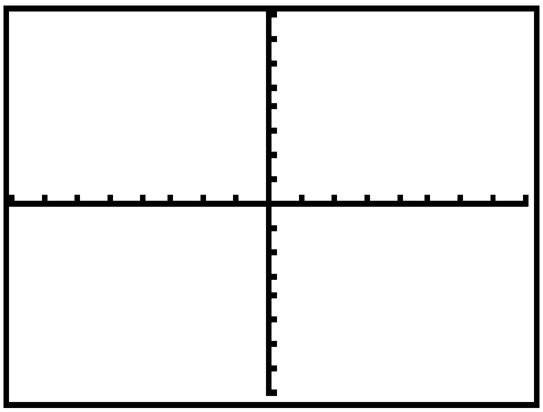
$Y_2 = 1(x + 2)$

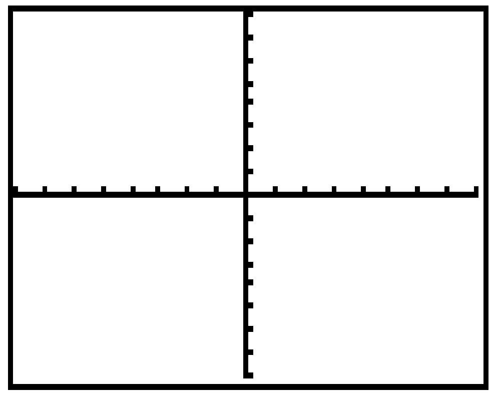


$Y_3 = 1(x + 4)$



$Y_4 = 1(x+6)$ $Y_5 = 1(x+8)$





Critical Statistics:

X- intercept

Y-intercept

Slope

Compare the Critical Statistics of Y_2, Y_3, Y_4, Y_5 to the Critical Statistics of Y_1.

What effect(s) does "changing" B have on the Basic Function?

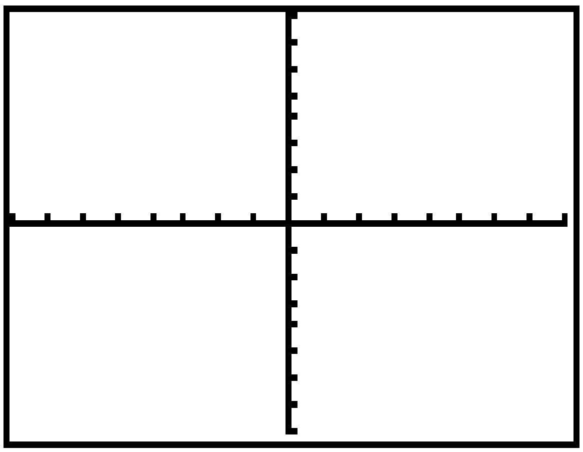
Generalizing (if B $\geq$ 0)

Adding a value of B to the X in the previous problems resulted in a transformation of the x-intercept to the_______________________.

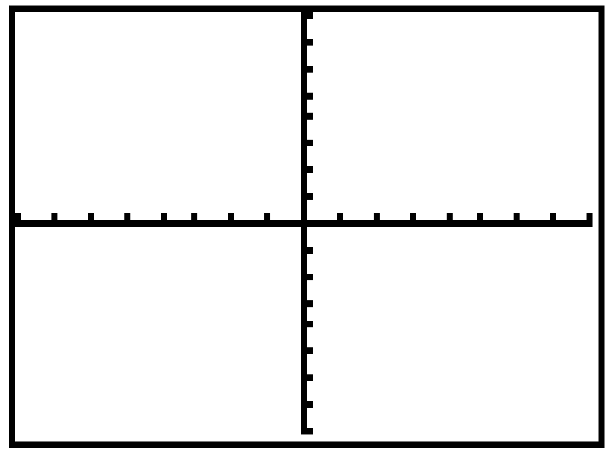
Adding a value of B to the X in the previous problems resulted in a transformation of the y-intercept to the _______________________.

Part 2: Sketch a graph for each equation below:
Note: Equations may be changed to the form Y= A(X + (-B))

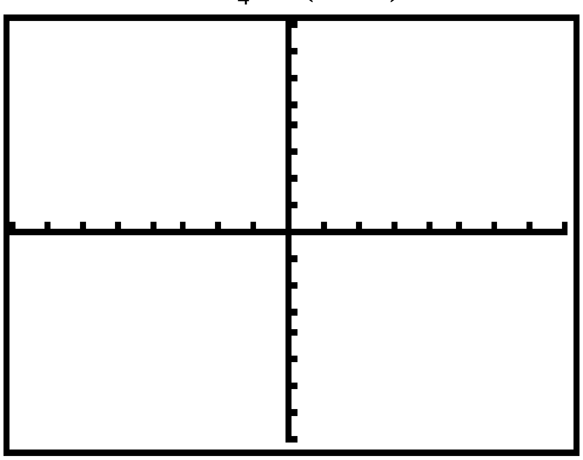
$Y_2 = 1(x-2)$



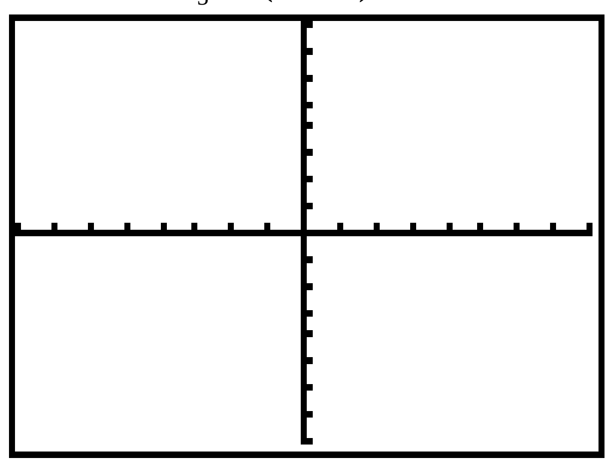
$Y_3 = 1(x-4)$



$Y_4 = 1(x-6)$



$Y_5 = 1(X-8)$



Critical Statistics:

X- intercept

Y-intercept

Slope

Compare the Critical Statistics of $Y_2, Y_3, Y_{4,} Y_5$ to the Critical Statistics of Y_1

What effect(s) does "changing" B have on the Basic Function??

Generalizing (if B ≥ 0)

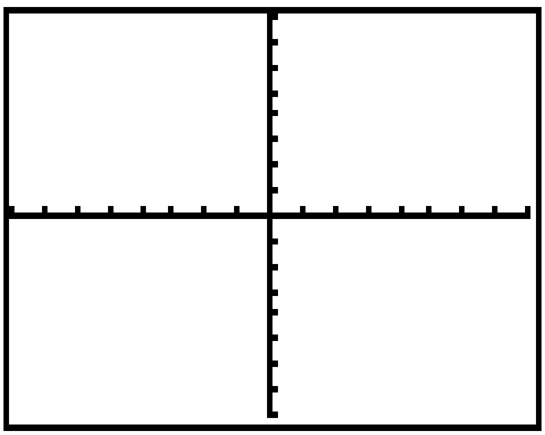
Subtracting a value of B to the X in the previous problems resulted in a transformation of the x-intercept to the_______________________.

Subtracting a value of B to the X in the previous problems resulted in a transformation of the y-intercept to the _____________________.

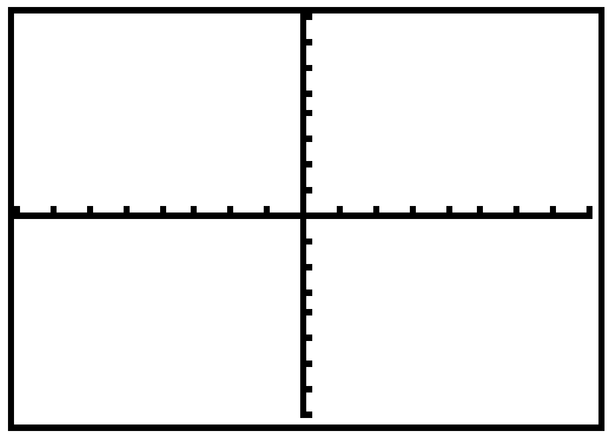
What was the slope in each of the problems above? _____________ Do you think that the slope has any effect on the graph?______________________________

Part 3: Sketch a graph for each of the following equations:

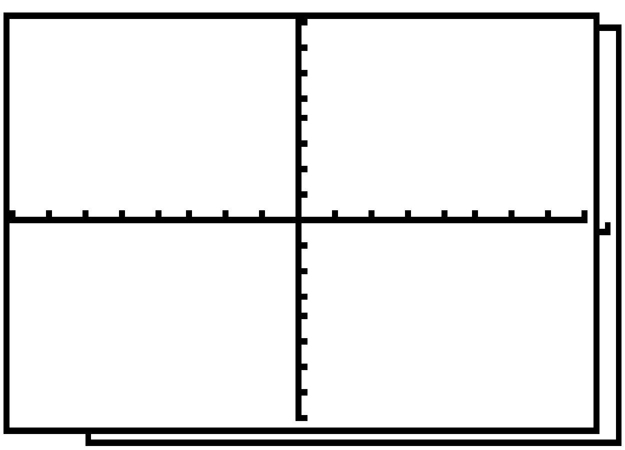
$$Y_2 = 2(X + 0)$$



$$Y_3 = 2(X + 2)$$



$$Y_4 = 2(X + 4)$$



$$Y_5 = 2(X + 3)$$

Critical Statistics:

X- intercept

Y-intercept

Slope

Compare the Critical Statistics of $Y_2, Y_3, Y_{4,} Y_5$ to the Critical Statistics of Y_1

What effect(s) does "changing" B have on the Basic Function?

Generalizing (if B ≥ 0)

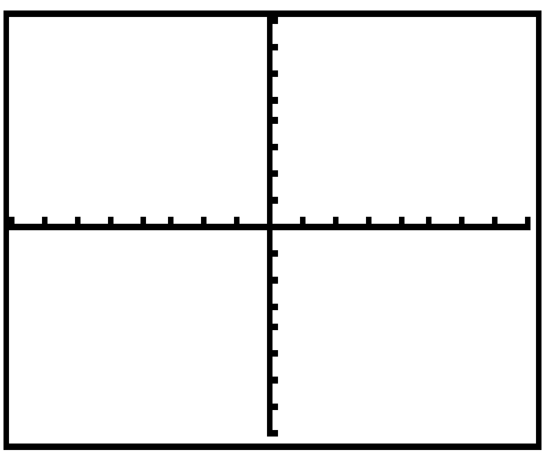
What was the slope in each of the problems above? _____________ Do you think that the slope has any effect on the graph? ____________

Adding a value of B to the X in the previous problems resulted in a transformation of the x-intercept to the________________________.

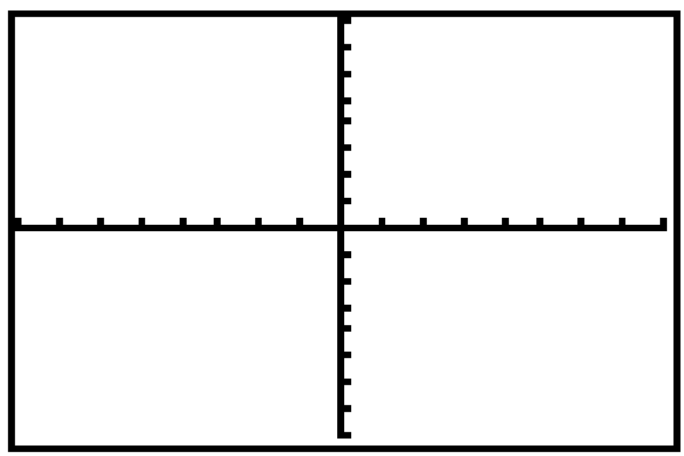
Adding a value of B to the X in the previous problems resulted in a transformation of the y-intercept to the ______________________.

Part 4: Sketch a graph of the following:

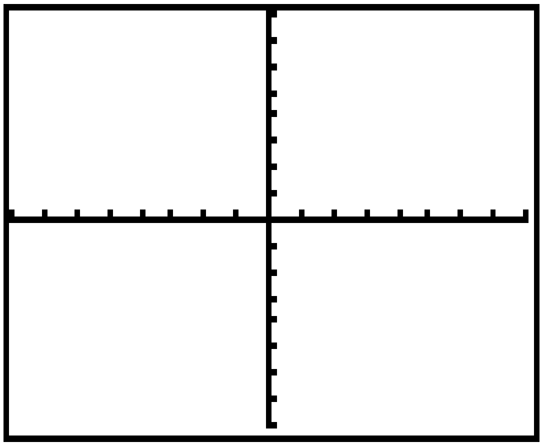
$Y_2 = 2(X + 0)$



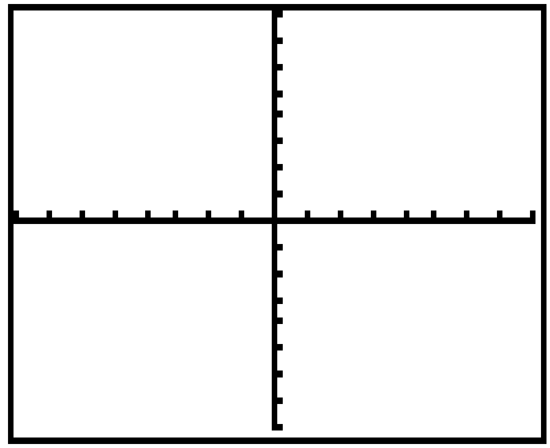
$Y_3 = 2(X - 2)$



$Y_4 = 2(X - 4)$



$Y_5 = 2(X - 3)$



Critical Statistics:

X- intercept

Y-intercept

Slope

Compare the Critical Statistics of $Y_2, Y_3, Y_{4,} Y_5$ to the Critical Statistics of Y_1

What effect(s) does “changing” B have on the Basic Function?

Generalizing

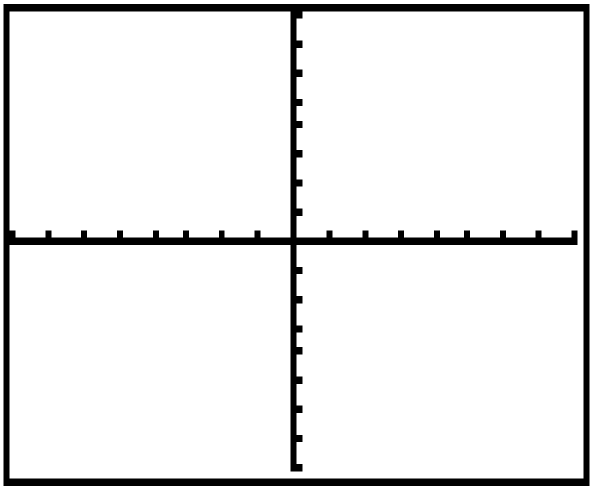
What was the slope in each of the problems above? ____________ Do you think that the slope has any effect on the graph?_____________________

Subtracting a value of B from the X in the previous problems resulted in a transformation of the x-intercept to the________________________.

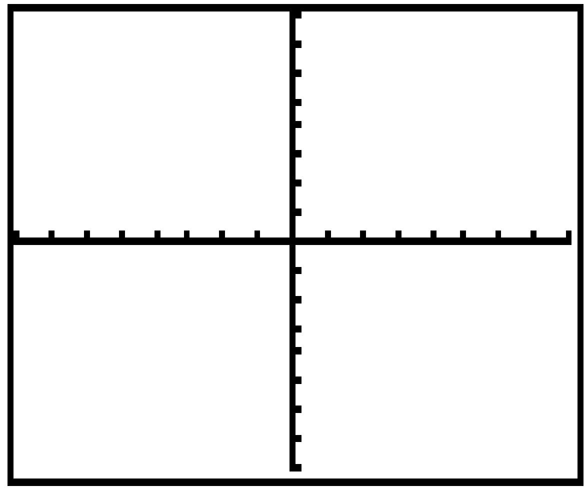
Subtracting a value of B from the X in the previous problems resulted in a transformation of the y-intercept to the ______________________.

Part 5: Sketch a graph of each of the following equations:

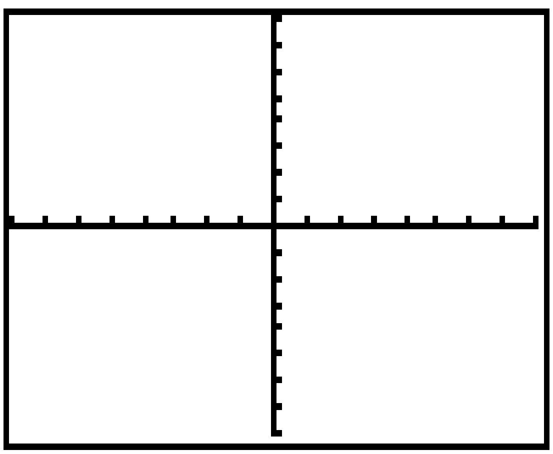
$Y_2 = {}^{-}1(X+0)$



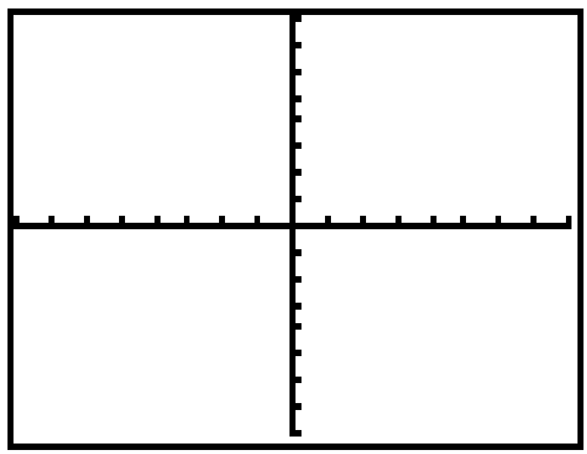
$Y_3 = {}^{-}1(X+2)$



$Y_4 = {}^{-}1(X+4)$



$Y_5 = {}^{-}1(X-4)$



Critical Statistics:

X- intercept

Y-intercept

Slope

Compare the Critical Statistics of $Y_2, Y_3, Y_{4,} Y_5$ to the Critical Statistics of Y_1

What effect(s) does "changing" B have on the Basic Function?

Generalizing

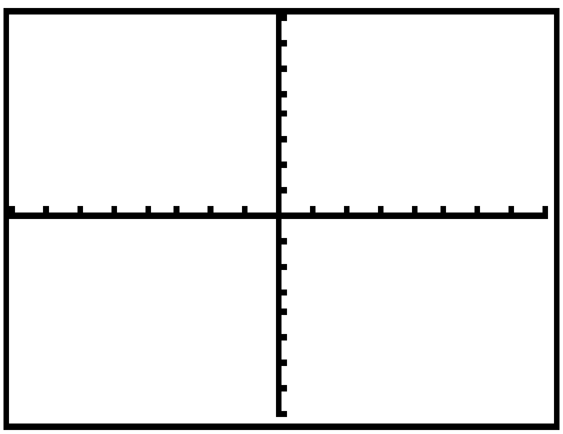
What was the slope in each of the problems above?_____________Do you think that the slope has any effect on the graph?________________

Adding a value of B to the X in the previous problems resulted in a transformation of the x-intercept to the________________________.

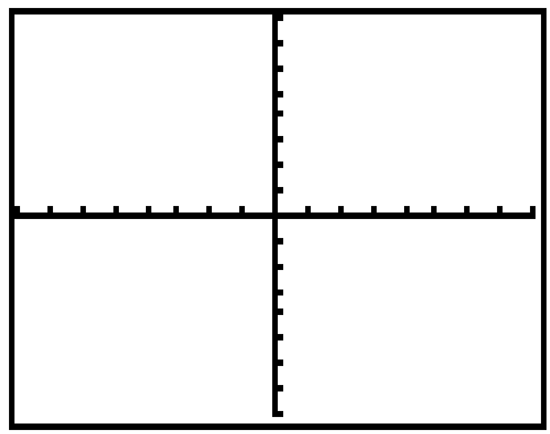
Adding a value of B to the X in the previous problems resulted in a transformation of the y-intercept to the ______________________.

Part 6: Sketch a graph of each of the following equations:

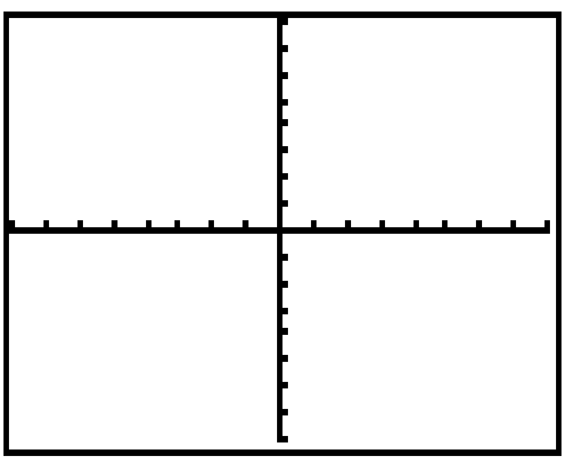
$Y_2 = {}^{-}2(X+0)$



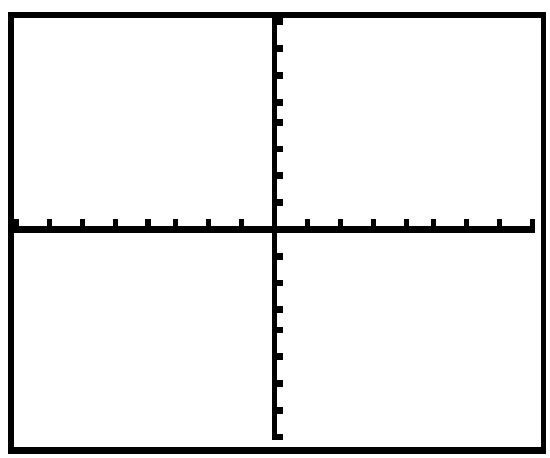
$Y_3 = {}^{-}2(X+2)$



$Y_4 = {}^{-}2(X-2)$



$Y_5 = {}^{-}2(X-4)$



Critical Statistics:

X- intercept

Y-intercept

Slope

Compare the Critical Statistics of $Y_2, Y_3, Y_{4,} Y_5$ to the Critical Statistics of Y_1

What effect(s) does “changing” B have on the Basic Function?

Generalizing

What was the slope in each of the problems above? ___________Do you think that the slope has any effect on the graph?___________________

Subtracting a value of B from the X in the previous problems resulted in a transformation of the x-intercept to the________________________.

Subtracting a value of B from the X in the previous problems resulted in a transformation of the y-intercept to the ______________________.

Answer the following COMPLETELY for equations of the form Y=A(X±B), A^{1} 0 and B^{3} 0

1. When the slope of a line is a positive 1, adding a value of B to the X results in

   ____

2. When the slope of a line is a positive 1, subtracting a value of B from the X results in

   ____

3. When the slope of a line is a A where A > 0, adding a value of B to the X results in

   ____

4. When the slope (A) of a line is a positive, subtracting a value of B from the X results in

   ____

5. When the slope of a line is a negative 1, adding a value of B to the X results in

   ____

6. When the slope of a line is a negative 1, subtracting a value of B from the X results in ____

7. When the slope of a line is negative (A < 0), adding a value of B to the X results in____

8. When the slope of a line is negative (A< 0), subtracting a value of B from the X results in____

9. You are given the slope of a line is 2, and the x-intercept is 5, then the y-intercept is __________
And an equation of the line is:_____________

10. You are given the slope of a line is 2 and the x-intercept is R, R >0, then the y-intercept is ___________
And an equation of the line is_______________

11. You are given the slope of a line is m and the x-intercept is R, R >0, then the y-intercept is __________
And an equation of the line is ______________

12. You are given the slope of a line is 2 and the y-intercept is 6, then the x-intercept is____________
And an equation of the line is______________

13. You are given the slope of a line is A and the y-intercept is B, then the x-intercept is _____________
And an equation of the line is _________________

Determine the Slope of a Line
Determine the Equation of a Line

Reporting Category: Equations and Inequalities
Related SOL: A.7 and A.8

Background Information:

- Students will need to know how to find the equation of a line given two points on the line or the graph of the line.
- Students will need to have used the graph and table functions of the graphing calculator.

Materials and Equipment:

"CARDS" created by the teacher. (See below for explanation.)

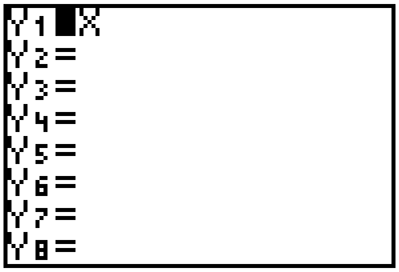
Notes to Teacher:

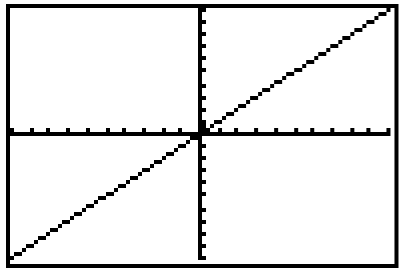
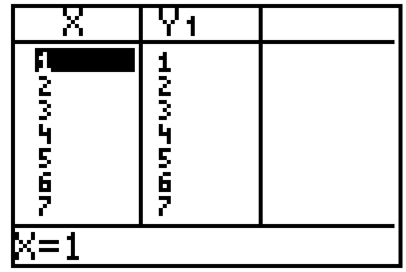
- On this card activity, the equation, graph and table are ALREADY matched. You will need to make multiple copies to use this activity fully.
- In this activity students will relate the equation of a line to the graph of the line and to a table of values.

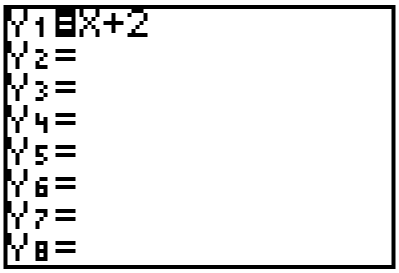
  Each piece of information may be used in more than one way.
- Suggestions:
  - Copy the handout, cut up the pieces, tape each on an index card, you will want to number the cards and have a "key" card so you can do a quick check of the students math.
  - Each day, hand out the index cards with the tables on them and have students find equations of their own line.
  - Repeat card activity at the beginning of class as a quick review daily.
  - Repeat the process with the graph.
- Another activity approach is to give students a graph the first day and ask them to write an equation for the graph. Give the students the table the second day and ask them to write the domain and range and determine if there is a function. On the third day provide students with the equation and ask them to graph it. Then, give all three pieces to them for matching.

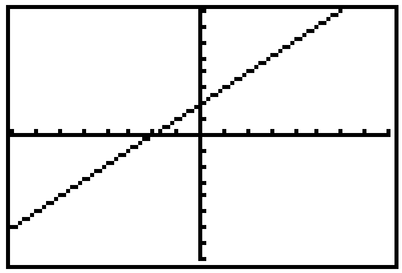
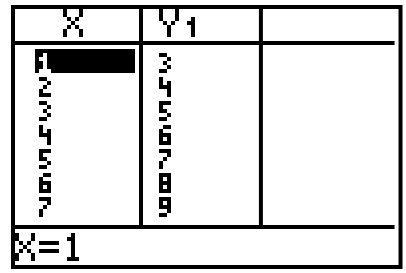
Bonus SOL A.15 Repeat the process with the equation having the students sketch the graph or give you a table of values for the equation that they are holding. Relate the f(x) to the ordinate on the graph.

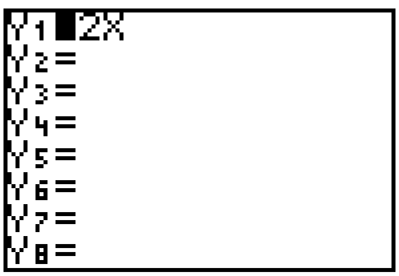
Card Activity: Match the Equation, Graph and Table

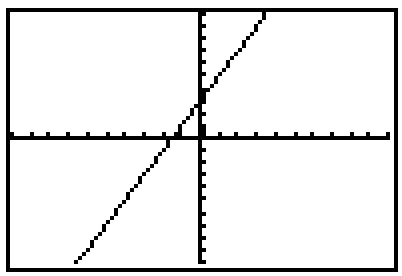
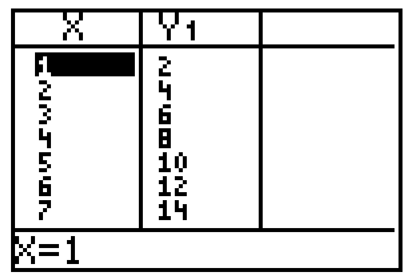


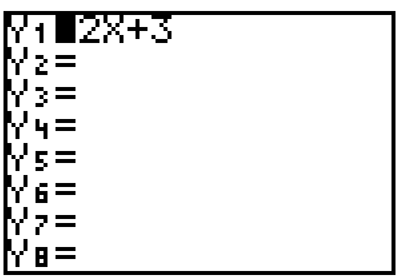



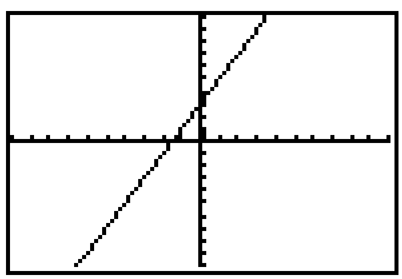
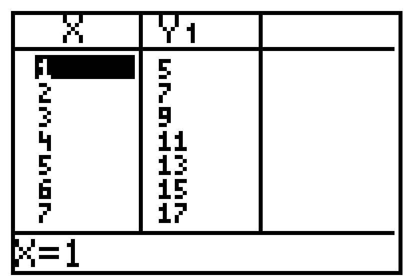


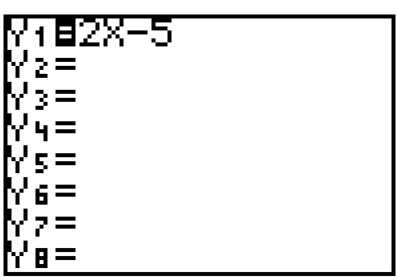



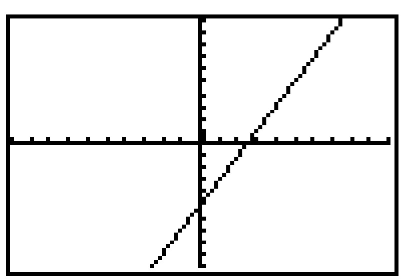
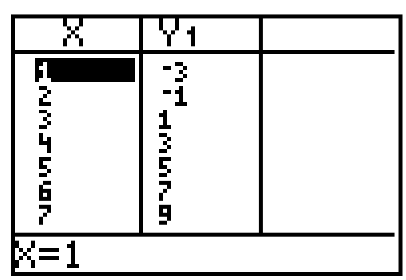


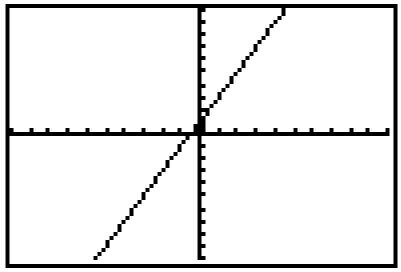




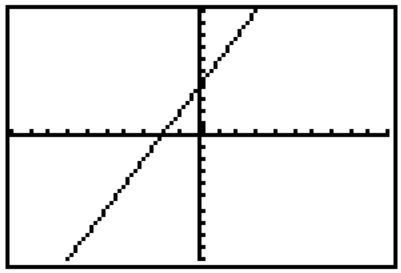
Y_1=2X+1
Y_2=
Y_3=
Y_4=
Y_5=
Y_6=
Y_7=
Y_8=



X	Y_1
1	3
2	5
3	7
4	9
5	11
6	13
7	15

X=1

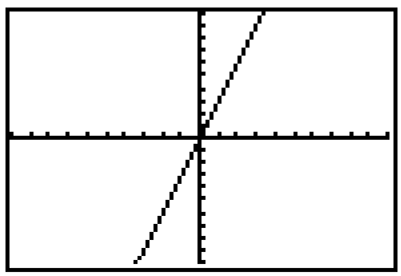
Y_1=2(X+2)
Y_2=
Y_3=
Y_4=
Y_5=
Y_6=
Y_7=
Y_8=



X	Y_1
1	6
2	8
3	10
4	12
5	14
6	16
7	18

X=1

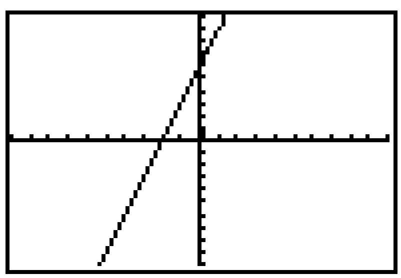
Y_1=3X
Y_2=
Y_3=
Y_4=
Y_5=
Y_6=
Y_7=
Y_8=



X	Y_1
1	3
2	6
3	9
4	12
5	15
6	18
7	21

X=1

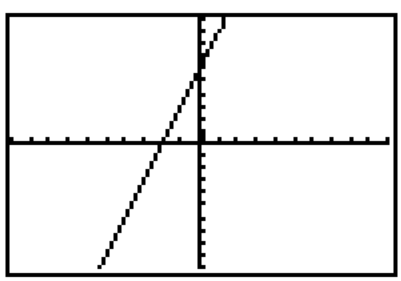
Y_1=3X+6
Y_2=
Y_3=
Y_4=
Y_5=
Y_6=
Y_7=
Y_8=



X	Y_1
1	9
2	12
3	15
4	18
5	21
6	24
7	27

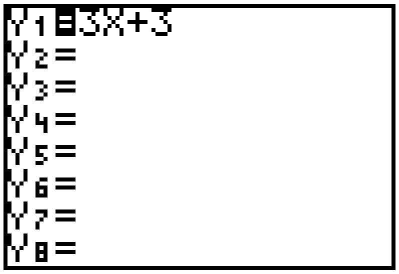
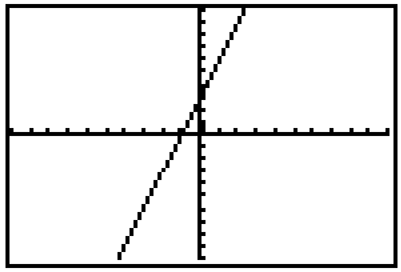
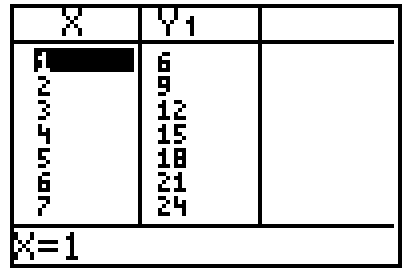
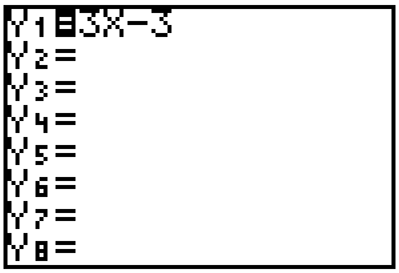
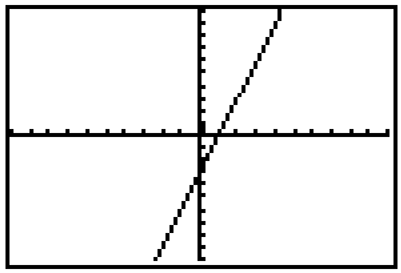
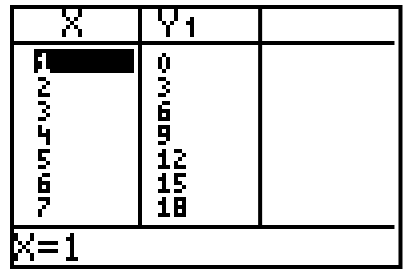
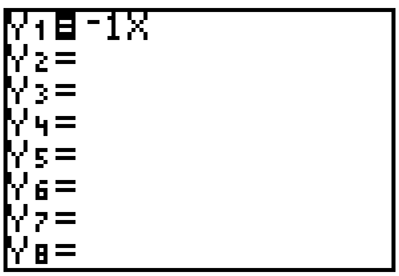
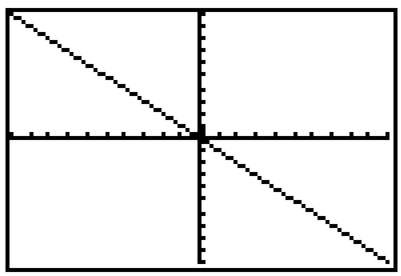
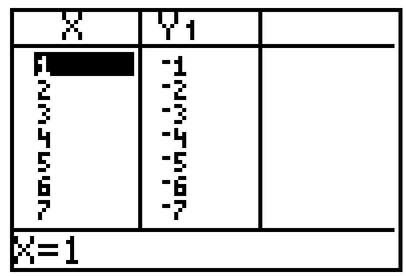
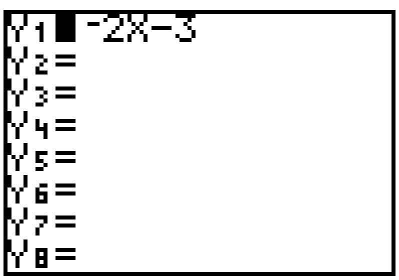
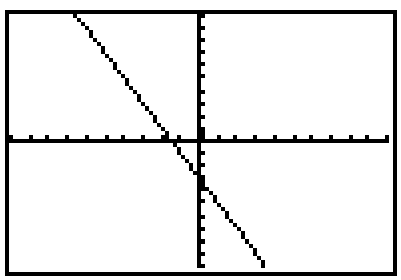
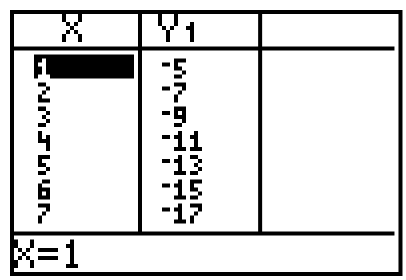
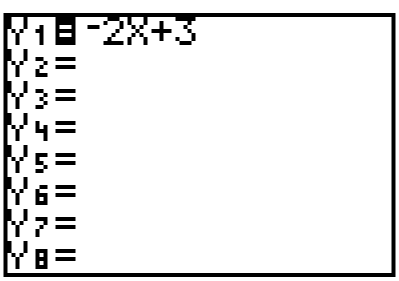
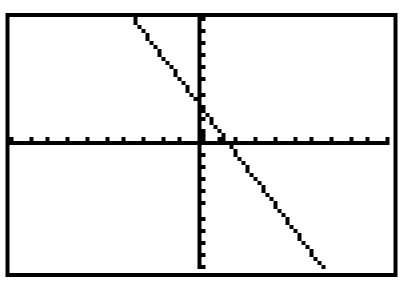
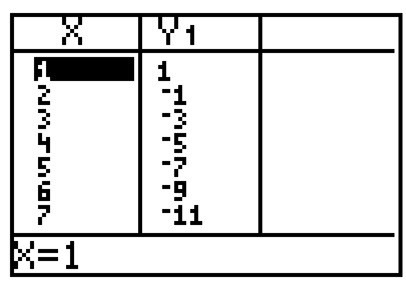
X=1

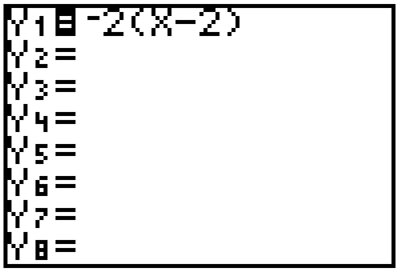
Y_1=3(X+2)
Y_2=
Y_3=
Y_4=
Y_5=
Y_6=
Y_7=
Y_8=

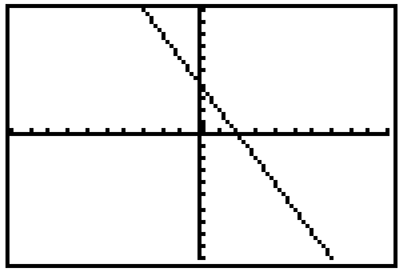


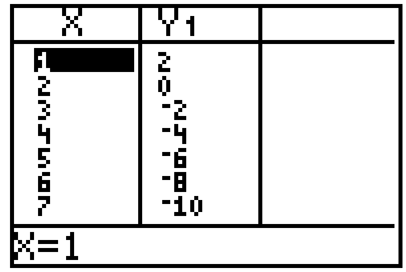
X	Y_1
1	9
2	12
3	15
4	18
5	21
6	24
7	27

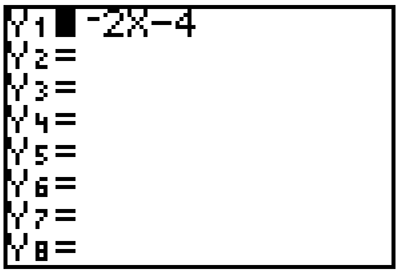
X=1

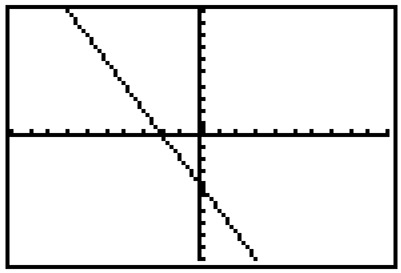

Y1=3X+3
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=


X Y1
1 6
2 9
3 12
4 15
5 18
6 21
7 24
X=1

Y1=3X-3
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=


X Y1
1 0
2 3
3 6
4 9
5 12
6 15
7 18
X=1

Y1= -1X
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=


X Y1
1 -1
2 -2
3 -3
4 -4
5 -5
6 -6
7 -7
X=1

Y1= -2X-3
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=


X Y1
1 -5
2 -7
3 -9
4 -11
5 -13
6 -15
7 -17
X=1

Y1= -2X+3
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=


X Y1
1 1
2 -1
3 -3
4 -5
5 -7
6 -9
7 -11
X=1

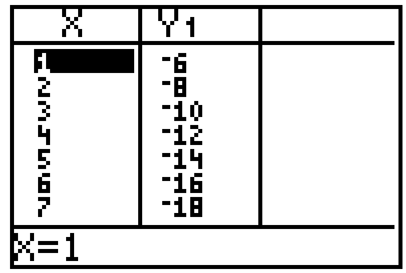

Y1=-2(X-2)
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=

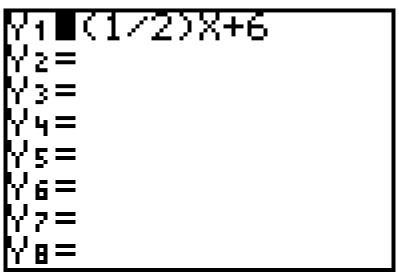


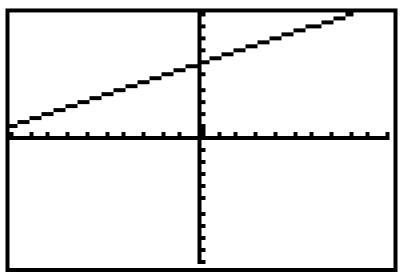

X
Y1
1
2
3
4
5
6
7
2
0
-2
-4
-6
-8
-10
X=1

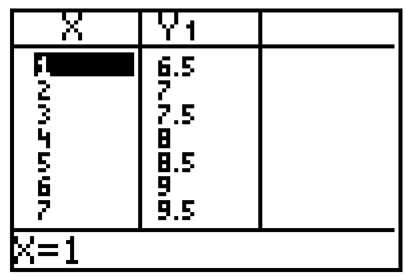

Y1=-2X-4
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=




X
Y1
1
2
3
4
5
6
7
-6
-8
-10
-12
-14
-16
-18
X=1


Y1=(1/2)X+6
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=




X
Y1
1
2
3
4
5
6
7
6.5
7
7.5
8
8.5
9
9.5
X=1

Write the Equation of a Line Given the Graph

Reporting Category: Equations and Inequalities
Related SOL A.8

Background Information:

- Students will need to know how to find the equation of a line from the graph.
- Students will need to know how to identify a x-intercept and a y-intercept.
- Students will need to have been introduced to the idea of slope.
- Students will need to have used the graph function of the graphing calculator.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- In this activity students will determine an equation of a line.
- In this activity students will "discover" the simplicity of finding the equation of a line if they can find the x and y intercepts first.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.
- After students have practiced with these graphs, demonstrate the use of the graphing calculator as a tool to determine the equation.

Bonus SOL A.18 Direct or Inverse Variation

Please Note: A **direct** variation is one whose graph passes through the origin. ($y=mx$, $m\neq0$)

An **inverse** variation is NOT THE OPPOSITE of a direct variation. Inverse variation establishes the relationship $Y = \frac{m}{x}$, $x \neq 0$ in which the product of the coordinates (x,y) is a constant nonzero product.

Activity sheet: Write the Equation of a Line Given the Graph

The graphs below are linear. This activity has three parts.

I. Use the "descriptors" below to describe each one.

Descriptor

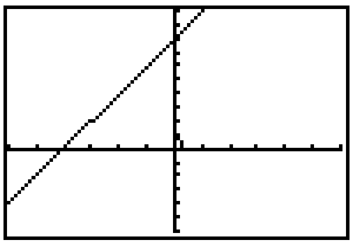
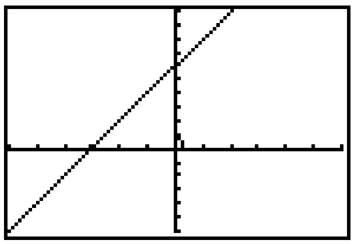
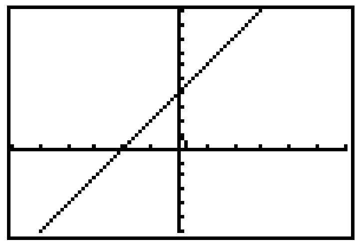
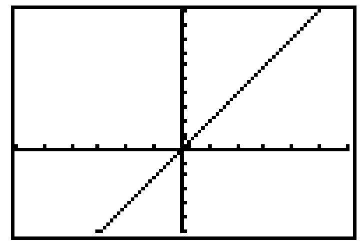
Direct — Increasing function

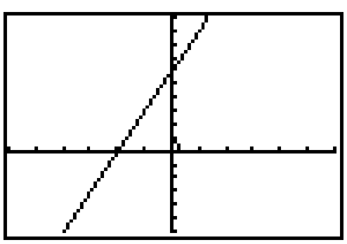
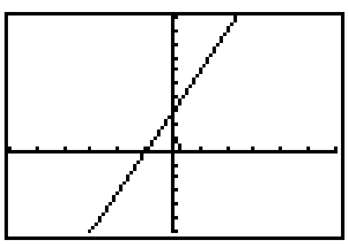
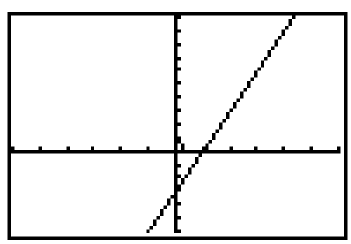
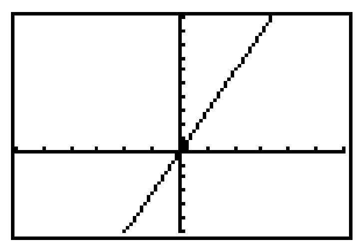
Decreasing function

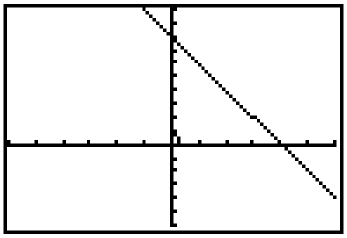
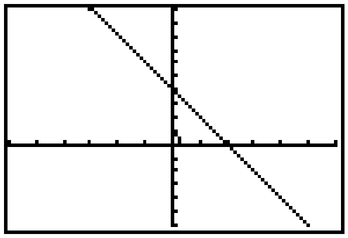
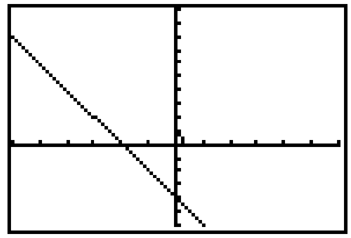
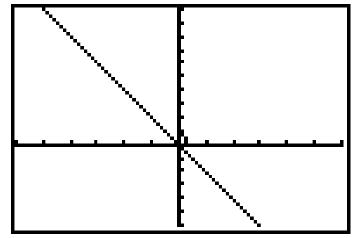
II. Determine the "critical" statistics of each.

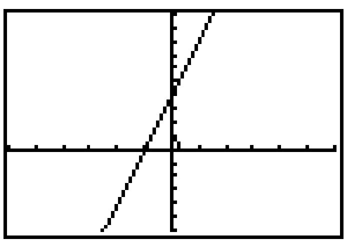
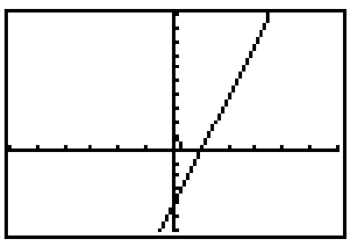
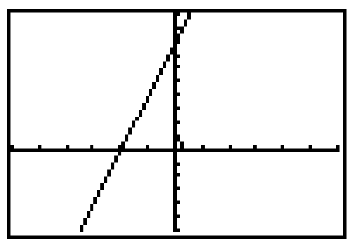
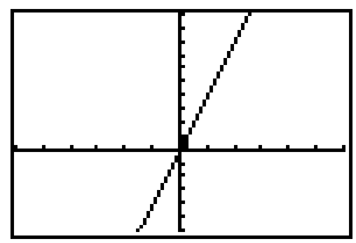
X- intercept
Y-intercept

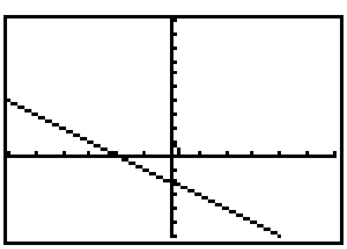
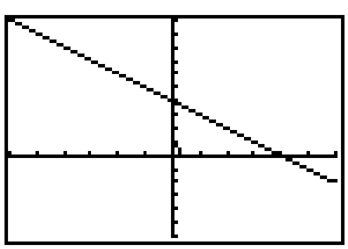
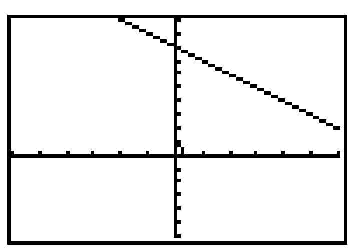
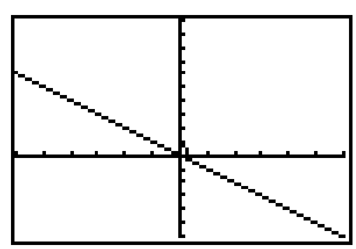
III. Find an equation of the line(s) shown.

Linear "Real" Problems

Reporting Category: Equations and Inequalities
Related SOL: A.5, A.8 and A.9

Background Information:

- The student will need to be able to generate tables to describe situations.
- The student will need to be able to enter data into lists and create a STAT PLOT with the graphing calculator.
- The students will need to be able to find the equation of a line.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- Extensive practice finding the equation of a line needs to be done prior to this activity.
- Students also benefit from generating the pattern from real life situations.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.
- **Bonus SOL A.2:** students represent verbal situations algebraically

---

Activity Sheet: Linear "Real" Problems

You are planning a single day road trip, BUT, you don't own a car. You'll have to rent a car from an agency.

Prestige Auto charges the following for a one day trip: $35 a day plus 24 cents per mile.

Make a data chart to indicate the charges you might incur.

Miles Driven	Start up Cost	Cost for Miles Driven	Total Cost of Trip
0			
1			
2			
3			
↓			

Questions:

What "values" change in this situation?

What "causes" these values to change?

What is the "independent variable"? (Causes the change)

What is the "dependent variable"? (Is affected by the change)

So, _______________ depends on _____________________
dependent independent

In words, write an equation to explain this situation.

Using algebraic notation, write an equation to explain this situation.

You are planning a single day road trip, BUT, you don't own a car. You'll have to rent a car from an agency.

Getaway Auto charges the following for a one day trip: $51 a day plus 16 cents per mile.

Make a data chart to indicate the charges you might incur.

Miles Driven	Start up Cost	Cost for Miles Driven	Total Cost of Trip
0			
1			
2			
3			
↓			

Questions:

What "values" change in this situation?

What "causes" these values to change?

What is the "independent variable"? (Causes the change)

What is the "dependent variable"? (Is affected by the change)

So, _______________ depends on _____________________
dependent independent

In words, write an equation to explain this situation.

Using algebraic notation, write an equation to explain this situation.

Complete this chart with the information requested

Miles Driven	Cost *Prestige*	Cost *Getaway*
50		
75		
100		
200		
250		
300		
325		

Questions:

Is there a particular number of miles driven when the cost of using *Prestige* is the same as using *Getaway*?

At how many miles driven?

Is there an “interval” of miles driven when the cost of using *Prestige* is smaller than using *Getaway*?

What is the interval?

After how many miles driven is it cheaper to use *Getaway*?

HOW ABOUT SAVING MONEY?

Nilda has $480 dollars in her sock drawer. She plans to save $30 per week from now on.

Make a chart to show the amount of money Nilda has in her sock drawer.

# weeks	Beginning Amount	Amount Added	Total Amount
0			
1			
2			
3			
↓			

Questions:

What "values" change in this situation?

What "causes" these values to change?

What is the "independent variable"? (Causes the change)

What is the "dependent variable"? (Is affected by the change)

So, _______________ depends on _____________________
dependent independent

In words, write an equation to explain this situation.

Using algebraic notation, write an equation to explain this situation.

At this rate, after how many weeks will she have $690 in her sock drawer?

At this rate, after how many weeks will she have $2040 in her sock drawer?

If her mom had put money in her sock drawer at the same rate each week, how long had Nilda's mom been saving before Nilda took over?

How about **Salaries?**

Manny just graduated from high school and has been offered a job.
He will start at $14,000 a year with the promise of a $500 raise per year.

Sonny just graduated from college and has been offered a job.
He will start at $20,000 a year with the promise of a $300 raise per year.

MAKE A CHART to show the amount of money Manny and Sonny will make each year.

Manny		Sonny	
# years experience	Salary	# years experience	Salary
0		0	
1		1	
2		2	
3		3	
4		4	
↓		↓	

QUESTIONS:

What "values" change in this situation?

What "causes" these values to change?

What is the "independent variable"? (Causes the change)

What is the "dependent variable"? (Is affected by the change)

So, _______________ depends on _____________________
dependent independent

In words, write an equation to explain each of these situations.

Using algebraic notation, write the two equations that explain these situations.

After what number of YEARS does Manny make more money than Sonny??

USE THE CALCULATOR

Place both of the equations in Y= of the calculator.

Use the TABLE to view the situations described.

What does the X represent in these equations?

What does each Y represent in these equations?

After what number of YEARS does Manny make more money than Sonny?

DO THE MATH

You want to know after how many YEARS will Manny and Sonny make the same amount of money.
Since Y represents the amount of money each person earns, and you want to know when these two amounts are the same, what can you do ALGEBRAICALLY to determine this equalization?

Questions:

What "values" change in this situation?

What "causes" these values to change?

What is the "independent variable"? (Causes the change)

What is the "dependent variable"? (Is affected by the change)

So, _______________ depends on _____________________
dependent independent

In words, write an equation to explain this situation.

Using algebraic notation, write an equation to explain this situation.

Discovery Lab: Motion

Reporting Category: Equations and Inequalities
Related SOL: A.9

Background Information:

- Students will need to be able to enter equations into Y= function of the graphing calculator
- Students will need to be able to enter data into LISTS and manipulate that data using the graphing calculator.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- This activity may be done on a variety of levels.
- There is a tremendous amount of problem solving involved.
- Students should work in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.
- For students who do not have an electric garage door opener, sample data is provided.

Activity Sheet: DISCOVERY LAB: MOTION

SITUATION: The garage door opener is at the back of your garage, farthest from the garage door itself.

PROBLEM: How fast must a person of average height walk in order to "clear" the door?

What is the maximum height of an "average walking" person that can "clear" the door?

HYPOTHESIS:
Student answers will vary.

PROCEDURE:
For a true Discovery Lab students will generate their own method of procedure.

OBSERVATIONS:
For a true Discovery Lab students generate this also.

CONCLUSIONS:
Students will share their conclusions with the class which should generate more questions.

For this venue, we will proceed as follows:

First we need some data collection:
Send students home to measure the distance the opener is from the door and the time it takes for the door to close.

SOME BASE DATA and SOME BASE RESULTS

Door: Distance door falls: 82"
Time: 12.5 sec
Speed of Door:

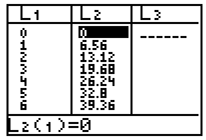
Opener: Distance to get "out": 230"
Time to get "out" th door:varies as speed of person

Door: Speed = distance door falls / time
= 82"/ 12.5 sec
= __________

Assume time is our independent variable and make a table of values to describe the door's movement.

Time	# inches Door falls
0	
1	
2	
3	
4	

Enter this data into L_1 and L_2



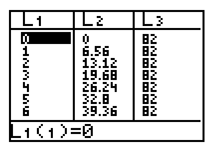
Is there a way to enter the time (independent variable) into L_1 and use a function to enter the number of inches the Door falls into L_2?

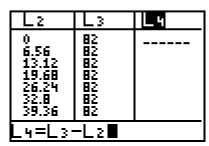
L_2=speed*L_1

Do we really want to know the distance the door falls? Or do we care how far from the ground the door is at any given second?

Let's continue our Table until we see the Pattern emerge.

Time	# inches Door Falls	Maximum Distance	# inches from the ground
0			
1			
2			
3			
4			





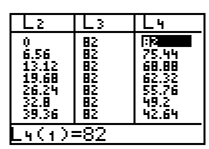
What did you put in L_3 to achieve these results?

Max distance - #inches Door falls = #inches from the ground

L_3-L_2=L_4

Or Max distance-(Speed* time) = #inches from the ground

L_3-(82/12.5)*L_1 = #inches from the ground



Can you translate this into function notation?

Let Y_1 be the distance from the ground (dependent variable) and X be the time (independent variable)

$Y_1 = 82 - 6.56X$

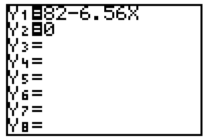
Now check the table to see the same values in Y_1 that are in L_4

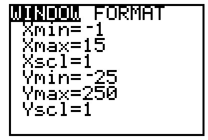
QUESTION 1:

What if a person is zero inches tall?
How fast/slow can he go to get out safely?

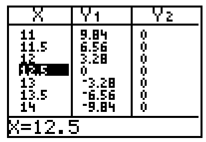
$Y_1 = 82 - 6.56X$
Y_2 = (person's height) = 0

Find the intersection:





Compare the intersection on the curve to the intersection on the table.



Think … the absolute slowest person to get out must be the absolute ____________ person to get out.

Calculate the speed the "slowest" and shortest person could travel:

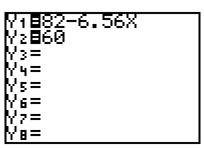
D = 230 T = 12.5 S = D/T
= 230/12.5
= 18.4" / sec.

QUESTION AGAIN

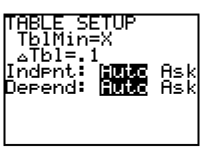
What if a person were 5' tall instead of 0" tall

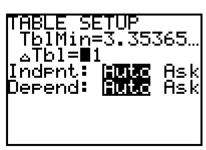
How fast would this person have to travel?

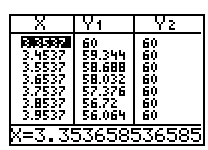
Remember X = Time



So the speed of our 5' person must be 230"/3.35 sec = 68.58 " / sec







Our average walker only had a speed of 52"/ sec.
Should we pick a tall average walker or a short average walker? Can you explain yourself?

Make another Table by hand.

Speed = 52”/sec

Time	Distance walked
0	
1	
2	
3	
4	
5	
6	

Does the distance the person walked matter?
Or is it how close he is to the door?

Speed = 52”/sec

Time	Distance from door
0	
1	
2	
3	
4	
5	
6	

It looks like this person can escape safely somewhere between 4 and 5 seconds.

Can we put a function for the distance from “out” in Y_2?
And $Y_3=0$.

Find the intersection between Y_2 and Y_3. What will that tell us? Remember, X = time.

So how tall can this person actually be to escape safely?

It appears the person can be 52.99 inches tall which is less than 4’5”.

Exploring Equations

Reporting Category: Equations and Inequalites
Related SOL: A.9

Background Information:

- Students will need to write equations for practical problems.
- Students will need to know how to use the Y= function of the graphing calculator.

Materials and Equipment

- Graphing calculator and view screen.
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- You may need to guide the students to use Y = 100 and find the intersections on the calculator.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Exploring Equations

The eighth grade needs to raise money for its end of the year field trip. Team 8A wants to sell popcorn at the Spring Fling Carnival while team 8B wants to sell cotton candy. The cost to rent the popcorn machine is $15.00 and a cotton candy maker cost $25.00. The cost of additional supplies for the popcorn is $0.05 per bag. The additional cost for the cotton candy is $0.10 per stick. Team 8A will sell the bags of popcorn for $0.50 each and 8B will sell their cotton candy for $0.75 per stick.

a) Each team needs to raise $100.00.
How many bags of popcorn will team 8A need to sell to reach this goal?

How many sticks of cotton candy will team 8B need to sell?

b) What is the least number of items each team would need to sell in order to avoid losing money on the sale?

c) At what point do both teams earn the same amount of profit?

Extension:
Change the selling price of popcorn to $0.75 and the cotton candy to $0.80.
How does this change the answer above?

Solving Quadratics Graphically

Reporting Category: Equations and Inequalities
Related SOL: A.14, AII. 10, AII. 8

Background Information:

- Students will need to know how to identify a x-intercept and a y-intercept.
- Students will need to have experience using the Y= function and the table function of the graphing calculator.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- In this activity students "discover" the significance of numbers in the quadratic equation.
- In this activity sheet, the equation, graph and table are ALREADY matched. You will need to make multiple copies to use this activity fully.
- In this activity students will relate the equation of a quadratic to the graph of the quadratic and to a table of values.
- Each piece of information may be used in more than one way...Suggestions:
  - Copy the handout, cut up the pieces, tape each on an card, you will want to number the cards and have a "key" card so you can do a quick check of the student's mathematics.
  - Each day, hand out the index cards with the tables on them, have students find equation of their own quadratic.
  - Repeat the activity at the beginning of class as a quick review daily.
  - Repeat the process with the graph.

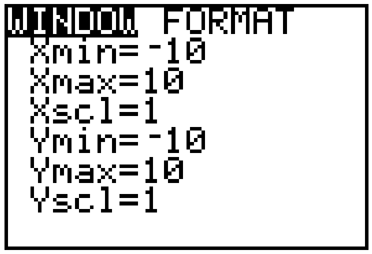
.

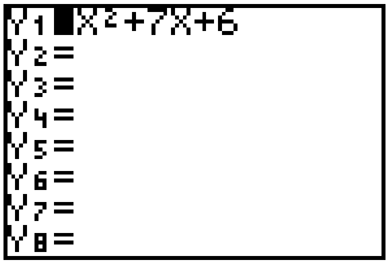
Bonus SOL A.15 Repeat the process with the equation having the students sketch the graph or give you a table of values for the equation that they are holding. Relate the f(x) to the ordinate on the graph.

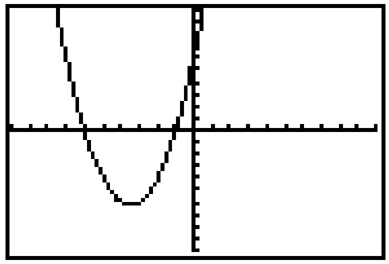
Bonus SOL AII.10 and AII.8 Discuss the stretching action of a GCF and how to determine if the graph has been stretched or shrunk and by what value. Discuss complex roots and why there are no real roots.

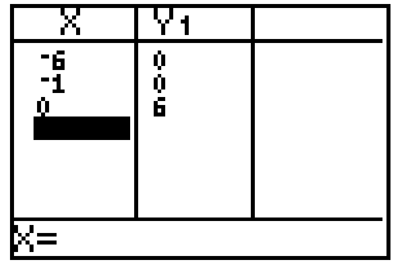
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

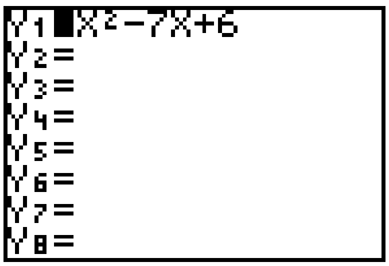
Activity Sheet: Match the quadratic equation to its graph and to its table of values.

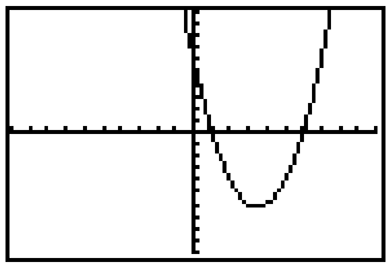


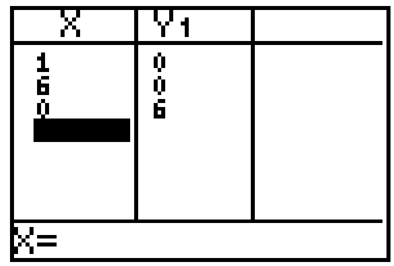


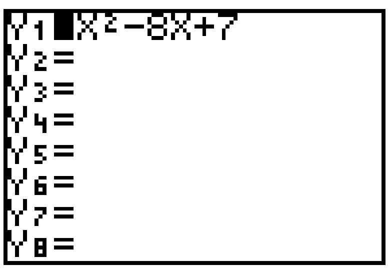


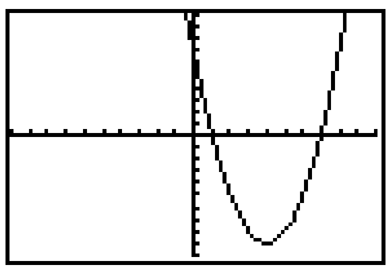


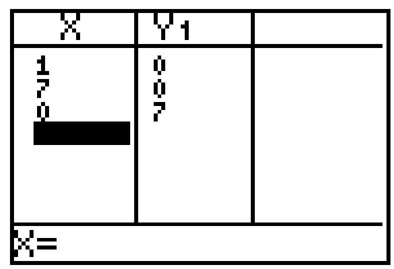


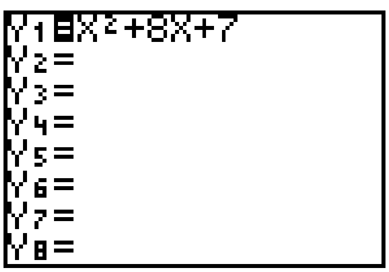


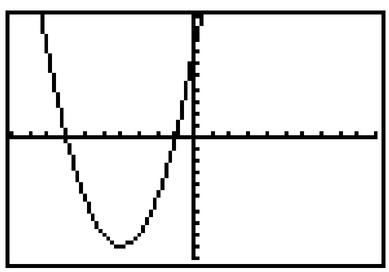


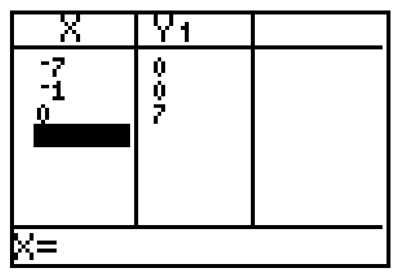


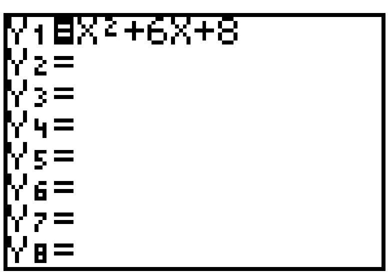


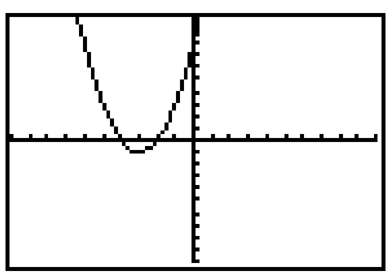


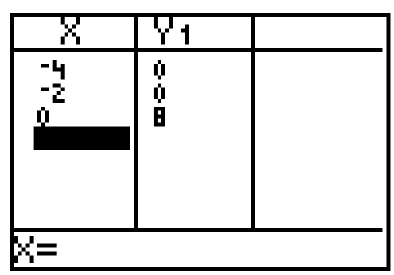


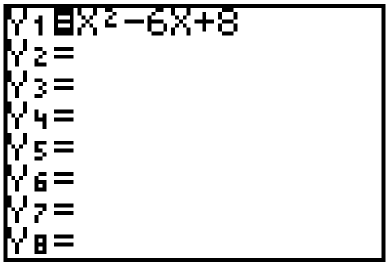
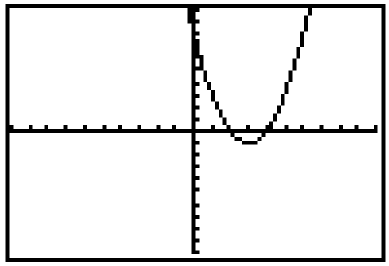
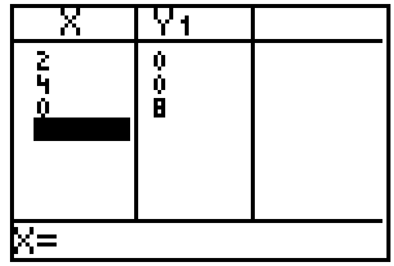
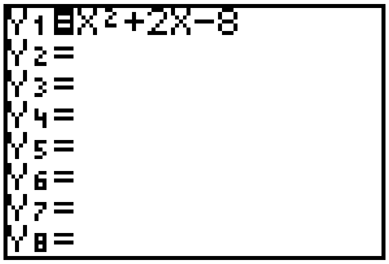
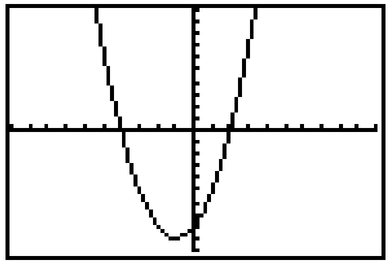
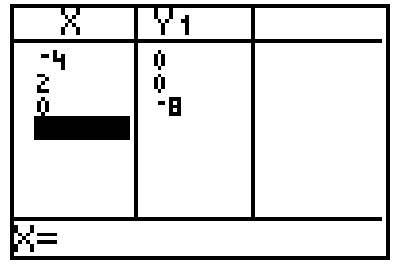
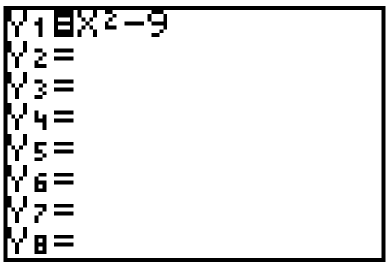
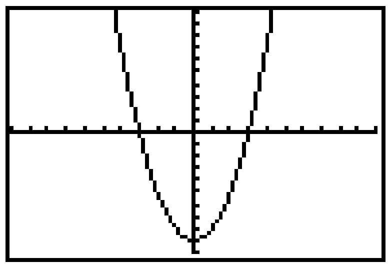
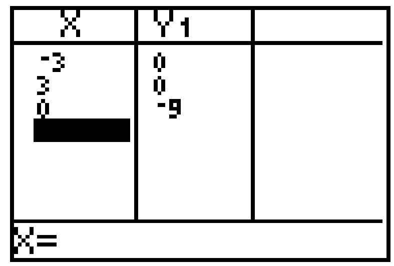
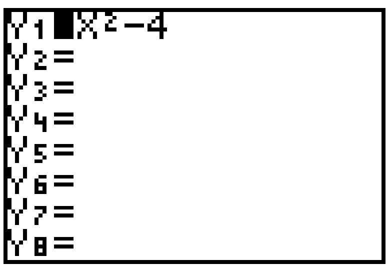
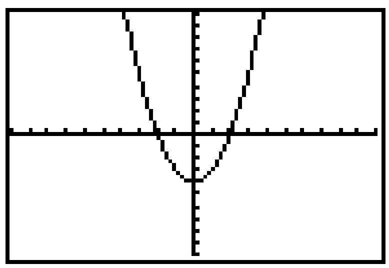
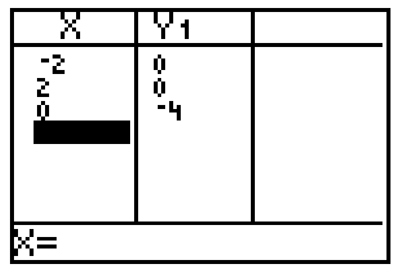
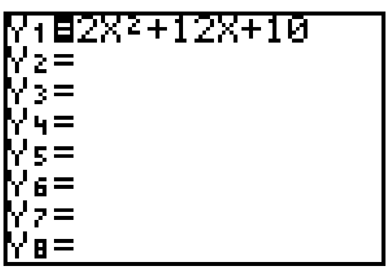
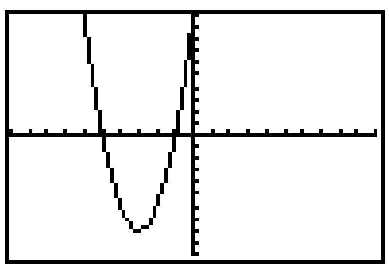
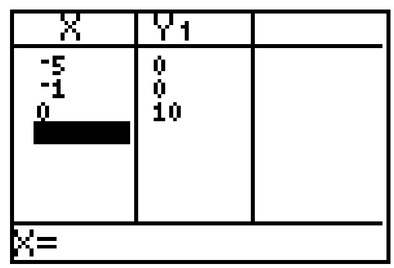




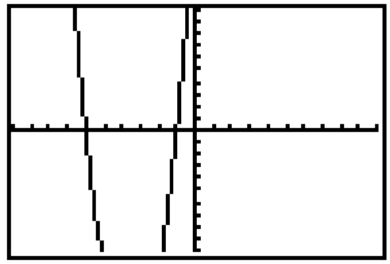







$Y_1=X^2-6X+8$
$Y_2=$
$Y_3=$
$Y_4=$
$Y_5=$
$Y_6=$
$Y_7=$
$Y_8=$


X Y_1
2 0
4 0
0 8
X=

$Y_1=X^2+2X-8$
$Y_2=$
$Y_3=$
$Y_4=$
$Y_5=$
$Y_6=$
$Y_7=$
$Y_8=$


X Y_1
-4 0
2 0
0 -8
X=

$Y_1=X^2-9$
$Y_2=$
$Y_3=$
$Y_4=$
$Y_5=$
$Y_6=$
$Y_7=$
$Y_8=$


X Y_1
-3 0
3 0
0 -9
X=

$Y_1=X^2-4$
$Y_2=$
$Y_3=$
$Y_4=$
$Y_5=$
$Y_6=$
$Y_7=$
$Y_8=$


X Y_1
-2 0
2 0
0 -4
X=

$Y_1=2X^2+12X+10$
$Y_2=$
$Y_3=$
$Y_4=$
$Y_5=$
$Y_6=$
$Y_7=$
$Y_8=$


X Y_1
-5 0
-1 0
0 10
X=

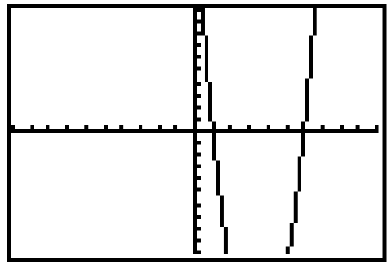
Y1 = 3X²+21X+18
Y2 =
Y3 =
Y4 =
Y5 =
Y6 =
Y7 =
Y8 =



X	Y1
-6	0
-1	0
0	18

X=

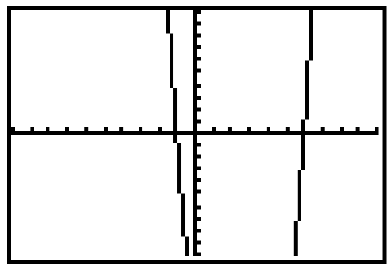
Y1 = 3X²-21X+18
Y2 =
Y3 =
Y4 =
Y5 =
Y6 =
Y7 =
Y8 =



X	Y1
1	0
6	0
0	18

X=

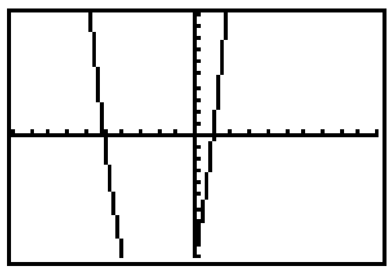
Y1 = 3X²-15X-18
Y2 =
Y3 =
Y4 =
Y5 =
Y6 =
Y7 =
Y8 =



X	Y1
-1	0
6	0
0	-18

X=

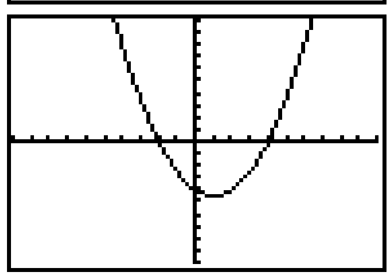
Y1 = 2X²+8X-10
Y2 =
Y3 =
Y4 =
Y5 =
Y6 =
Y7 =
Y8 =



X	Y1
-5	0
1	0
0	-10

X=

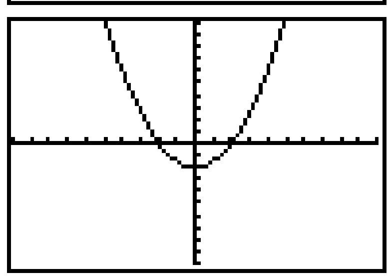
Y1 = (1/2)(X²-2X-8
)
Y2 =
Y3 =
Y4 =
Y5 =
Y6 =
Y7 =



X	Y1
-2	0
4	0
0	-4

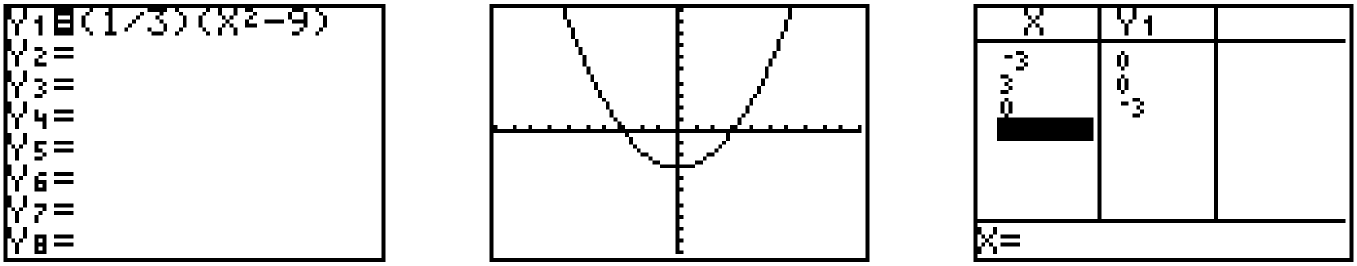
X=

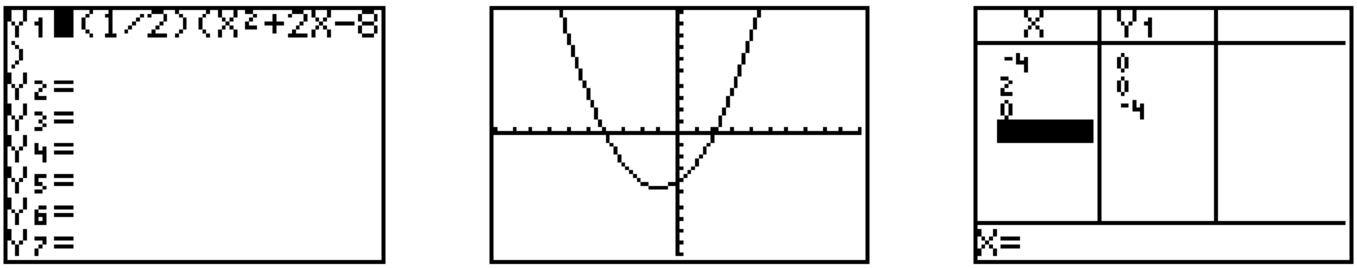
Y1 = (1/2)(X²-4)
Y2 =
Y3 =
Y4 =
Y5 =
Y6 =
Y7 =
Y8 =

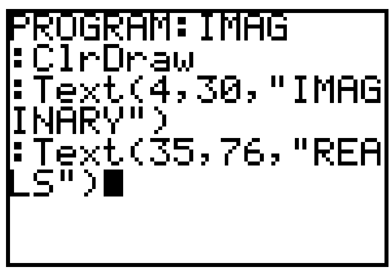


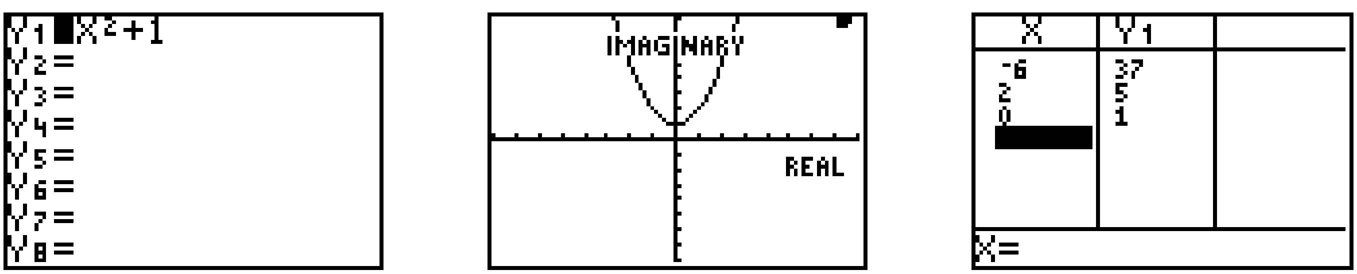
X	Y1
-2	0
2	0
0	-2

X=


Y1=(1/3)(X²-9)
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=
X
Y1
-3
3
0
0
0
-3
X=


Y1=(1/2)(X²+2X-8
)
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
X
Y1
-4
2
0
0
0
-4
X=


PROGRAM:IMAG
:ClrDraw
:Text(4,30,"IMAG
INARY")
:Text(35,76,"REA
LS")


Y1=X²+1
Y2=
Y3=
Y4=
Y5=
Y6=
Y7=
Y8=
IMAGINARY
REAL
X
Y1
-6
2
0
37
5
1
X=

Getting to Know Your Calculator
Measures of Central Tendencies (Statistics)

Reporting Category: Expressions and Operations
Related SOL: A.2 and A.17

Background Information:

Students need no prior experience with the graphing calculator to do this activity.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- Teacher needs to know EVERYTHING for this activity or be willing to learn as you go.
- Since calculators keystrokes differ, you will want to have your manual handy.
- Equations such as $2x+3x=5x$ can be verified as either true or false by using the boolean function of the graphing calculator. The boolean value of True is stored in your calculator as a 1, and False is stored as a 0. When prompted, your calculator determines whether an equation is True or False and returns a value of 1 or 0, respectively.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Getting to Know Your Calculator

Order of Operations

This activity is done from the HOME SCREEN. Keystrokes are exactly as shown.

Problem	Analytically	Calculator
$\frac{1}{2}+\frac{3}{4}$		
$\frac{21}{2}+9*2$		
$5+9*2$		
$(5+9)*2$		
$2(5+9)$		
-3^2		
$(-3)^2$		
$(8-2)/(2+1)$		
$8-2/2+1$		
$100/5*2$		
$100/5(2)$		

TEST MENU

This activity is done from the HOME SCREEN.
Find the TEST Menu on your calculator, then arrow to the desired symbol.
If a statement is true the calculator returns a 1.

Using the Test Menu	Calculator Returns?
$3(4+5)=3*4+3*5$	
$3(4+5)=3*4+5$	

STO

This activity is done from the home screen.

Keystrokes: STO▷ into a variable name.

Whatever value you store into a variable name remains that value until you change it manually or until you TRACE on a graph.

$5\rightarrow x$

$-7\rightarrow y$

Test Menu Again	Calculator Returns?
$3(x+y)=3x+3y$	
$3(x+y)=3x+y$	

Activity Sheet: Measures of Central Tendency

This activity is done in Lists.

Data is entered into L_1.

Determine the measures of central tendencies,

Scenario: Some class at XXX High school took their first test and received the following scores:

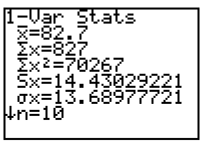
55, 64, 83, 92, 100, 77, 86, 92, 80, 98

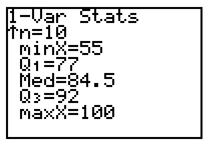
Q1: What was the mean score?

Q2: What was the median score?

Q3: What was the range of scores?

Q4? What was the mode of the scores?





Scenario extended: Two students were absent the day the test was given. The make up test resulted the two following grades: Student 1 received 92 and Student 2 received 72.

Q5: What is the new mean score?

Q6: What is the new median score?

Q7: What is the range of scores?

Q8: What is the mode of the scores?

Scenario extended again: Student 2 never got his absence excused so his score is recorded as a zero.

Q9: What effect does this zero have on the mean, median, and mode of this set of data?

Factoring

Reporting Category: Expressions and Operations
Related SOL: A.12

Background Information:

- Students need to know how to enter equations into Y= function of the graphing calculator.
- Students need to know how to set a window and set a table in the graphing calculator.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- It is the intent of this activity that students "discover" the relationship between an equation written in quadratic form and an equation written in factored form. A bonus from this activity is that students begin to realize that the "roots" or zeroes of a quadratic have a significant place on the graph and that the graph may be used to find the roots.
- This lesson should not be done in a single class period. The ideas take awhile to "sink in", therefore it is suggested that this "investigation" be done as a precursor to factoring and be done over a period of a week.
- This lesson is not intended to take the place of your instruction on factoring.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Factoring

Beginning "setup":

Window : $[^-8, 8]$ by $[^-8, 8]$ 			Table: TblStart = $^-8$

ΔTbl = 1

Note: You **MAY** have to **ADJUST** your window in order to "see" the **COMPLETE GRAPH.**

Part 1: 1. Enter: $Y_1 = x^2 + 4x + 3$ — Sketch 			$Y_2 = (x+1)(x+3)$ — Table

2. Enter: $Y_1 = x^2 + 7x + 10$ — Sketch 			$Y_2 = (x+2)(x+5)$ — Table

3. Enter: $Y_1 = x^2 + 7x + 6$ — Sketch 			$Y_2 = (x+6)(x+1)$ — Table

4. Enter: $Y_1 = x^2 + 8x + 7$ — Sketch 			$Y_2 = (x+7)(x+1)$ — Table

5. Enter: $Y_1 = x^2 + 10x + 9$ $Y_2 = (x+9)(x+1)$

Sketch Table

Questions: In how many "places" did these graphs cross (intersect) the x- axis?

What is the y- coordinate of a point on the x- axis?

SO, when y = ___________, the function crosses the x- axis!!

Part 2: 6. Enter: $Y_1 = x^2 - 5x + 4$ $Y_2 = (x-4)(x-1)$

Sketch Table

7. Enter: $Y_1 = x^2 - 8x + 15$ $Y_2 = (x-5)(x-3)$

Sketch Table

8. Enter: $Y_1 = x^2 - 8x + 12$ $Y_2 = (x-6)(x-2)$

Sketch Table

9. Enter: $Y_1 = x^2 - 9x + 14$ $Y_2 = (x-7)(x-2)$

Sketch Table

10. Enter: $Y_1 = x^2 - 13x + 30$ $Y_2 = (x-10)(x-3)$

Sketch Table

Questions: In how many "places" did these graphs cross (intersect) the x- axis?

What is the y- coordinate of a point on the x- axis?

SO, when y = ___________, the function crosses the x- axis!!

Part 3: 11. Enter: $Y_1 = x^2 - 1$ $Y_2 = (x+1)(x-1)$

12. Enter: $Y_1 = x^2 - 4$ $Y_2 = (x+2)(x-2)$

13. Enter: $Y_1 = x^2 - 9$ $Y_2 = (x+3)(x-3)$

14. Enter: $Y_1 = x^2 - 25$ $Y_2 = (x+5)(x-5)$

15. Enter: $Y_1 = x^2 - 100$ $Y_2 = (x+10)(x-10)$

Questions: In how many "places" did these graphs cross (intersect) the x- axis?

What is the y- coordinate of a point on the x- axis?

SO, when y = ___________, the function crosses the x- axis!!

Part 4: 16. Enter: $Y_1 = x^2 - x - 2$ $Y_2 =$

17. Enter: $Y_1 = x^2 + x - 2$ $Y_2 =$

18. Enter: $Y_1 = x^2 - x - 6$ $Y_2 =$

19. Enter: $Y_1 = x^2 + x - 6$ $Y_2 =$

20. Enter: $Y_1 = x^2 - 3x - 10$ $Y_2 =$

Questions: In how many "places" did these graphs cross (intersect) the x- axis?

What is the y-coordinate of a point on the x- axis?

SO, when y = ___________, the function crosses the x- axis!!

Estimating Square Roots

Reporting Category: Expressions and Operations
Related SOL: A.13

Background Information:

- Students need to be able to identify the square root button on the calculator.
- Students need to be able to use the list capability of the graphing calculator.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- It is the intent of this activity that students will recognize the significance of "memorizing" integral square roots.
- This is such a simple "twist" on an old idea that is very effective.
- A bonus for this activity is that students learn that "Squaring undoes SquareRooting."
- Students may work alone or in pairs on this activity.

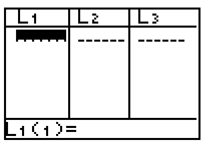
Activity Sheet: Estimating Square roots

Make a table to show the following:

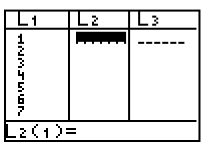
X	$\sqrt{X}$

After students have taken the square roots of numbers "manually", have students set up a table using the List capability of the calculator.

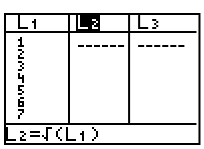
<ENTER>



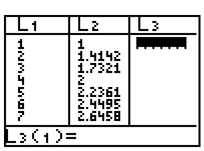
Enter X 's in L_1



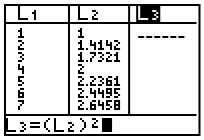
Enter $\sqrt{L_1}$ into L_2



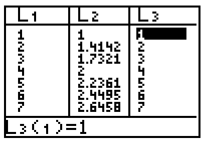
Correct results are as follows:



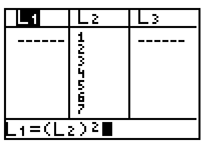
Ask students to use L_3 and "re-create" L_1 using L_2.
Students will hopefully enter the data shown below.

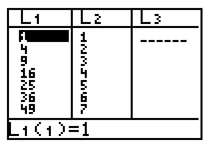


To result in:



The "expected" result should be





Now the students should be able to estimate square roots with relative ease to the nearest tenth.

Extension: Find a value of x for which w and z are both positive integers, given $\sqrt{x+47}=z$ and $\sqrt{x-12}=w$.

Patterns

Reporting Category: Relations and Functions
Related SOL: A.5

Background Information:

- Students can perform this activity with only intuition.
- The problems can be revisited (see description below).
- Students will search for simple patterns in teacher generated data lists.
- Students will manually graph the data by making a table of ordered pairs, where rank order is the x-coordinate and the data point is the y-coordinate and search for a generalized pattern.
- Students can use the graphing calculator STAT PLOT function to graph the data and "see" the pattern.

Materials and Equipment:

- None unless you decide to use this for the Bonus SOL A.8.
- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- This may be used as a very simple beginning activity for students to intuitively search for patterns.
- You will want to "set up" the problem by having students assign 1,2,3,4 etc. respectively to the numbers in the list. Then you can STAT PLOT.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Bonus SOL A.8 Write an equation of the line.

Activity Sheet: **Patterns**

"Let us teach guessing."
George Polya

Directions: Find the next logical number in the given sequences of numbers.

1)	1	5	9	13	17	21	______
2)	4	8	12	16	20	24	______
3)	6	11	16	21	26	______	
4)	5	10	15	20	25	______	
5)	1	4	9	16	25	______	
6)	4	9	16	25	36	______	
7)	4	12	24	40	60	84	______
8)	180	360	540	720	900	______	
9)	0	2	5	9	14	20	______

10) A E F H I K L M N T V W
B C D G J O P Q R S U

NOTE: The letters of the alphabet have been separated into two groups.
Where do the X, Y, and Z go?

Suggestion: Students may manually graph these data lists as ordered pairs to "link" this type of activity to functions.
Students may try to write expressions to represent the pattern

Extension: SOL A.8 Students may use the LIST and STAT capabilities of the graphics calculator to validate their predictions.

Square Patio Patterns
(adapted from Math Connects: Patterns, Functions, and Algebra)

Reporting Category: Relations and Functions
Related SOL: A.5 and AII.11

Background Information:

Students need to recognize the existence of a pattern.

Materials and Equipment:

- Teacher will need to have materials to perform the SQUARE PATIO problem;

Corners	Marshmallows
Border Stabilizers	Colored Toothpick
Frames	Wooden Toothpicks
Tiles	Squares cut to the length of the wooden toothpicks

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

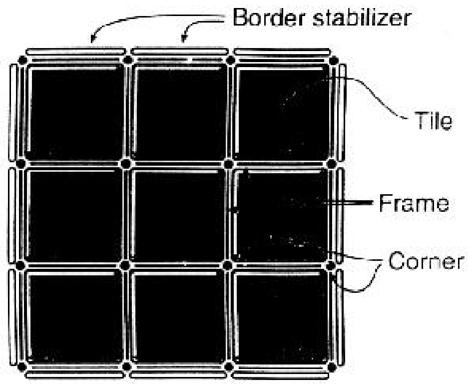
Notes to Teacher:

- This is a group activity and takes at least 2 days: one day to construct the square patios and collect the data and one day to analyze the data.
- This activity may be revisited many times

SOL A.11	Polynomial addition
SOL A.5	Domain, range and function
SOL A.4	Matrices and organization
SOL A.8	Find an equation of a line given two points
SOL AII.11	Matrix multiplication

Activity Sheet: Square-Patio Patterns

Build as many square-patios as you can in the fashion described below.



A model of a three-by-three square patio

Patio Dimension	Tiles Needed	Frames Needed	Corners Needed	Border Stabilizers
1(by 1)				
2(by 2)				
3(by 3)				
4(by 4)				
5(by 5)				
6(by 6)				
7(by 7)				
8(by 8)				

THINK #1:

Are you "seeing" any patterns emerging??

Is it easy to predict the number to Tiles needed for the different sized patios?

How many Tiles would you expect to need for a patio that is 10 (by 10) ?
How many Tiles would you expect to need for a patio that is 20 by 20) ?
How many Tiles would you expect to need for a patio that is n (by n)?

Do you know any "mathematical" vocabulary that describes the number of Tiles needed for each sized patio?

THINK #2

Sometimes there is **SO** much data that we cannot find patterns easily. We must look in logical places for patterns. Sometimes we "stumble" across the patterns.

On what does each piece of data DEPEND? In other words, does the number of Border Stabilizers DEPEND on the number of Corners or the size of the Patio?

Can you find a PATTERN that describes the relationship between the size of the Patio and the number of Border Stabilizers needed?
Do you know any "mathematical" vocabulary that describes the number of Border Stabilizers for each sized patio?

Can you write a "formula" to describe the relationship between Patio size and # Border Stabilizers that is true no matter how large the Patio becomes?

THINK #3 This is the BIG ONE!!

Does is seem reasonable that the number of Corners and the number of Frames also DEPEND on the Patio size?

Can you find a RELATIONSHIP between the Patio size and the number of Frames?
(You may want to consider looking at the number of Tiles for a HINT).

Can you find a RELATIONSHIP between the Patio size and the number of Corners?
(I needed to draw a few pictures first to see this one).

A II.11 Matrix multiplication

All that is needed here is a few prices for the Tiles, Corners, Border Stabilizers, and Frames.

Teacher may determine these prices or students may actually go to a hardware store and collect these prices.

Once a price has been determined, the student may use matrix multiplication to determine the cost of building a “square patio” of any size.

Domain and Range

Reporting Category: Relations and Functions
Related SOL: A.5

Background Information:

Students will need to know what it means to generate a table of values for a given rule.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.
- This activity relates domain and range with the terms independent and dependent variable.

Bonus SOL A.2 Students are evaluating an expression for a given replacement of values.

Bonus SOL A.7 Slope now has a meaning.

Activity Sheet: Domain and Range

A. Given the rates below, make a table of 5 values relating time and distance.

1. 40 mph
2. 16 ft/sec
3. .065 m/sec
4. $1\frac{3}{7}$ m/min

B. Fill in the Blank

5. Time is the ________________variable which constitutes the _________________ of the function. This variable is "plotted" along the ______________axis.

6. Distance is the ________________variable which constitutes the _________________ of the function. This variable is "plotted" along the ______________axis.

C. Explain yourself.

7. So, ________________ depends on _________________.
(dependent) (independent)

D. Applications

8. There are 365 days per year. (Assume leap year does not exist.)
Today is your birthday. Make a table to show the number of days old you were at {8, 9, 10, 11, 12} years old .
Name the DOMAIN.____________
Name the RANGE. ____________

9. According to the 1982 Guinness Book of World Records, Sammy Baugh, Washington has Highest Lifetime Punting Average of 45.1 yards per punt.
If he punted 6 times per game, make a table of the total number of yards he most likely punted after 12 games.
Name the DOMAIN.____________
Name the RANGE. ______________

10. According to the Bureau of Census, the United States and D.C. averaged 70.3 people per square mile of land.
Make a table to show the number of people in 1,000,000; 2,000,000; and 3,000,000 square miles.
If the U.S. and D.C. make up 3,536,278 square miles of land, predict our population.

Inverse Variations

Reporting Category: Relations and Functions
Related SOL: A.18

Background Information:

- Students will need to be able to enter equations into Y= function of the graphing calculator.
- Students should be familiar with the terms: direct variation, positive, negative slopes.
- Students will need to be familiar with perfect squares.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- This lesson is partially borrowed from Physical Science.
- You may need to refresh your memory of BOYLE'S LAW
  k = PV; Pressure (P) times Volume (V) is a constant (k).
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Bonus SOL A.1 Solving literal equations
Bonus SOL A.12 Introduction into factoring or reinforce factoring
Bonus SOL A.13 Discovery of square roots

Activity Sheet: Inverse Variations

Boyle's Law: If you decrease the volume of a container of gas, the pressure of the gas will increase, (provided the temperature does not change.)

$$P * V = k$$

Assume that for this particular gas, k = 18.

Make a table of values to illustrate PV phenomenon when k= 18.

Example: (Teacher should help student generate the values for V.)

P	V
1	
2	
3	
4	
6	
9	
12	
18	

Enter this data into L_1 and L_2

Discussion: What do you notice about L_2 as L_1 increases??

(Students should notice that there is a point where the values in L_2 begin to repeat or "turnabout".)
NOTE: "Turnabout" refers to the decreasing values beginning to increase or the increasing values beginning to decrease.

Discussion: Is this a function by our standard definition of function?

Make a STAT PLOT of this data

Students are now asked to determine visually if this is a function??
Discussion should follow about using ONLY visual clues.

Students may now be asked to "pinpoint where the "turnabout" place is?

Students are now asked to solve this equation for P?

P • V = 18

$$P = \frac{18}{V}$$

Keystrokes: Free Floating Cursor

Have students estimate where they believe the "turnabout" is.

Have students multiply on the HOME SCREEN the values of X and Y.

Students may place the equation for P into Y=.

Students should be TOLD that this a visual representation of an inverse variation.

Students should note that $L_1 * L_2$ is constant

But $L_1 + L_2$ is different

Have students repeat this process with various values of "k" such as 36, 48, 144.
Students could also compare different gases.

Where is the "turnabout"?

Is the "turnabout" an integral number?

Of what significance is this "turnabout"?

What if I knew that the "turnabout" was exactly at 4, what could you tell me about the value of k?

So how many integral factors does a perfect square have?

How many integral factors does a non-perfect square have?

Inverse Relationships

Reporting Category: Relations and Functions
Related SOL: AII.9

Background Information:

- Students will need to algebraically find the inverse of a function.
- Students will need to know how to use the MODE function of the graphing calculator.

Materials and Equipment

- Graphing calculator and view screen.
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- You will want to "play" with the window settings in parametric before you give this activity to students. By changing the T_{step} students can begin to get the "idea" of a LIMIT without really discussing any calculus.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Inverse Relationships

Original function: $Y = 1 + 2x$

Set the graphing calculator to Parametric.

Set the window at $[^-5,5]\ by\ [^-5,5]$

Allow $T_{step} = 1$

Graphing in Parametric is a little unusual. The original function is entered as two equations.

The following equations are "equivalent" to the original function.

$$X_{1T} = T$$
$$Y_{1T} = 1 + 2T$$

Sketch a graph of what you see.

The Inverse of a function is found algebraically by switching the x and y variables and solving for Y.

In graphing, the inverse may be "seen" by switching the equations in the parametric setting.

Enter the following equations:

$$X_{2T} = 1 + 2T$$
$$Y_{2T} = T$$

On the same graph as above, sketch these new equations.

TRY THIS

Trace along the graph until the cursor is visible on the screen.
Jump up and down along each of the "curves."

What do you notice about the relationship between the x and y coordinates as you switch between the graphs?

The Inverse of a function is supposed to be a reflection over the Y = x line.
To "view" this enter the following:

$$X_{3T} = T$$
$$Y_{3T} = T$$

What do you think?

Is the inverse of every function always a function?

TRY SOME MORE

Original function: $Y = 3 - 5x$

Enter for parametric:

$$X_{1T} = T$$
$$Y_{1T} = 3 - 5T$$

Enter the Inverse, and the Y = x line.

Sketch a graph of what you see.

Is the inverse of every function always a function?

You are on your own now.

Original function: $Y = \dfrac{1+2x}{3x}$

Original function: $Y = \sqrt{(2x+1)}$

Original function: $Y = \dfrac{3}{x}$

Investigating Graphs of Polynomials

Reporting Category: Relations and Functions
Related SOL: AII.15

Background Information:

- Students will need to know the significance of the roots of a quadratic.
- Students will need to be able to enter equations into Y= function of the graphing calculator.

Materials and Equipment:

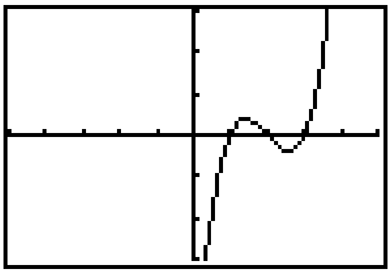
- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

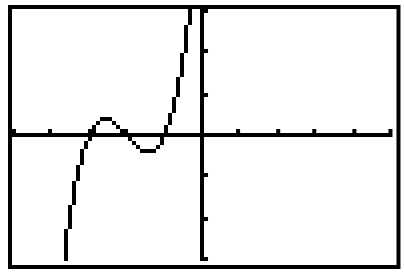
Notes to Teacher:

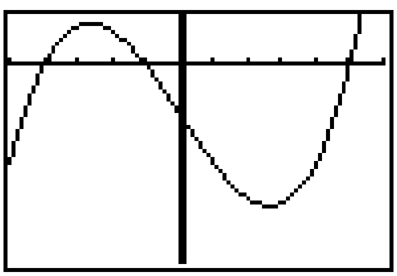
- This lesson is investigative by nature. It is not intended to take the place of instruction.
- Algebra I students may also be challenged by this lesson.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

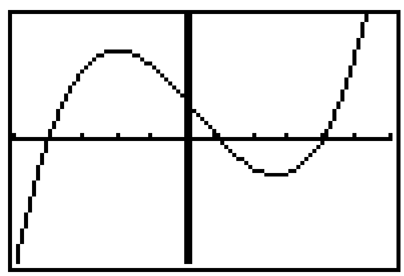
Activity Sheet: Investigating Graphs of Polynomials

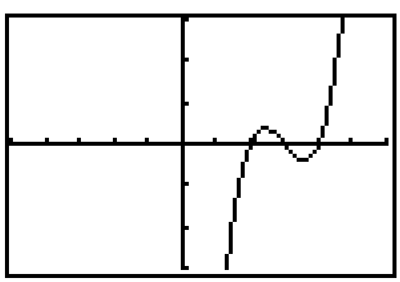
"Guess" the binomials that would result in the graphs below.
Graph your guess to check.











What generalizations have you made about polynomials and their "roots"?

Infinite Geometric Sequences

Reporting Category: Relations and Functions
Related SOL: AII. 16

Background Information:

Students will need to be able to generate data based on a premise.

Materials and Equipment

Each student will need:

Graphing calculator and handouts

Notes to Teacher:

- This activity is set up, students may use only the graphing calculator; however, teachers may use different kinds of balls i.e. tennis balls, basketballs, softballs, ping pong balls, golf balls, and allow students to perform this activity as an experiment and actually collect the data.
- A Data Collector (EA-100 or CBL) also could be used to gather data.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Infinite Geometric Sequences

With each bounce, a ball reaches a height equal to $\frac{3}{4}$ the height of its previous bounce. It is shown that on the first bounce it achieves a height of 25 feet. A second ball, which reaches a height of 18 feet on its first bounce, bounces $\frac{4}{5}$ of its previous height.

1. Construct a table of values that shows the height of each ball for each bounce.

Bounce	Ball 1	Ball 2

2. Will the second ball ever bounce higher than the first one? If so, at which bounce?

3. For how many bounces do both balls stay above 10 feet?

4. When do balls "stop" bouncing? (Achieve a height less than 3 inches.)

5. What minimum initial height (to the nearest foot) would you have to insure for each ball to guarantee that they each stay at least 8 feet above the ground by the 6th bounce?

Extension:
What about the fractions involved in this problem make the ball react in the manner described?

Matrices

Reporting Category: Statistics
Related SOL: A.4

Background Information:

- Students will need to know how to organize data into matrix form.
- Students will need to know how to enter data into a matrix in the graphing calculator.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- It is the intent of this activity that students will organize and manipulate data in matrix form.
- A bonus to this activity is that students are exposed to the distributive property without "calling it " the distributive property.
- When you get to #11, you may want to refer back to **A.2, Getting to know your calculator** –Boolean Algebra.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Matrices

Enter the following information in Matrix form into Matrix A and Matrix B on your calculator.
When finished return to the HOME SCREEN

	shoes	socks	jackets	ties	rings
Matrix A	11	14	3	7	2
Matrix B	15	18	6	4	20

Find the following:

1. $[A]+[B]=$

2. Explain a situation that describes the operation in #1.

3. $[\mathrm{A}]-[\mathrm{B}]=$

4. Explain a situation that describes the operation in #3.

5. $5[\mathrm{A}]=$

6. Explain a situation that describes the operation in #5.

7. Explain the process necessary to do the following:
Multiply Matrix $[\mathrm{A}]$ by 11.

Actual Result =

8. Explain the process necessary to do the following:
Add Matrix $[A]$ to Matrix $[B]$ and multiply this result by 5.

Actual Result =

9. Explain the process necessary to do the following:
Take Matrix $[A]$ and Add 5 times Matrix $[B]$.

Actual Result =

10. Explain the process necessary to do the following:
Multiply Matrix $[A]$ by 11, Multiply Matrix $[B]$ by 4 and then Add the result together.

Actual Result =

The following are algebraic.

11. $5(x-9)=$

12. $8(9+4x)=$

13. $x(y+7)=$

14 $4(3x-9r)=$

15. $6(5x+3y)=$

16. $5x(7-3y)=$

17. $4a(5c+2r)=$

18. $(10z-9)5=$

19. $(8+9T)6=$

20. The measure of an angle is described as $m\angle ABC$ and is described as $4x+19$. Find the expression for 6 times $m\angle ABC$.

Matrices and the Square Patio

Reporting Category: Statistics
Related SOL: A.4

Background Information:

- Students will need to have already done the SQUARE-PATIO Patterns.(See Relations and Functions A.5)
- Students will need to know how to enter data into matrices on the graphing calculator.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Bonus SOL A.11 Students can relate this to polynomial operations.

Activity Sheet: **Matrices**

Directions: Enter your data from the Square-Patio problem (size 1(by 1)) into Matrix $[A]$.

Example: $[A] =$ 1 4 4 4

Enter your data from the Square-Patio problem(size 2 (by 2)) into Matrix $[B]$.

1. Perform the following operation: $[A]+[B]$

   Result:

   What construction "items" were added together?

   Why is it unreasonable to add the # tiles to the # corners?

   What is a reasonable answer for the following: $9x+6y+4x+3y$

2. Perform the following operation: $[B]-[A]$

   Result:

   What is the "implication" of the operation?

   What is a reasonable answer for the following: $5x+12y-3x.$

3. Perform the following operation: $6[B]$.

   Result:

   Explain a situation that describes the operation in #3.

   What mathematical property is illustrated by the operation in #3?

4. Perform the following operation: $6([B]+[A]).$

   Result:

   Perform the following operation: $6[B]+[A].$

   Result:

   Compare the results of the operations in #4.

Getting Around to PI

Reporting Category: Statistics
Related SOL: A.17

Background Information:

- Students will need to be able to measure distances.
- Students will need to know how to find measures of central tendencies.
- Students will need to be able to enter data into LISTS of the graphing calculator and manipulate this data within the LISTS.
- Students will need to be able to create a Box and Whisker Plot of the data using the STAT PLOT function of the graphing calculator.

Materials and Equipment:

- The teacher will need to have a collection of circular items. Cylinders work well but circles cut out of cardboard (thickness is needed) are easier to store and are easier to collect.
- Linear measuring tools
- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- The level of teacher involvement in this activity depends on the amount of background information the students have and the amount of expertise they have acquired on the calculator.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Getting Around to PI

Part I. Collect the data

1. Pick one item from the collection of cylinders or circles.
2. Measure and record its circumference to the nearest millimeter.
3. Measure and record its diameter to the nearest millimeter.
4. Repeat steps #1- 3 for a variety of other cylinders.

Item	Circumference	Diameter

Part II. Enter and use the data

1. Enter the data above into your calculator. Circumference in L_1 and Diameter in L_2.
2. Use the calculator to find the **ratio of circumference to diameter**.
   Store this in a new list. L_1 / L_2 STO▷ L_3
3. Use the calculator to find the measures of central tendency for the **ratio.**
   Mean
   Median
   Mode
   Range
   What does each measure tell you about the data?
   Are there any outliers that need to be accounted for? If yes, what should be done?
   Which measure of central tendency is the most useful here? Why?
4. Use the calculator to make a box and whisker plot of the ratio. Draw a quick sketch of the plot. What does the box and whisker show about the data?

   If you had any outliers above, delete them from you list now. How does the Box-and-Whisker Plot change? Why?

5. Can you generate an algorithm or formula that allows you to find the circumference of a circle if you know the diameter? How about the diameter if you know the circumference?

Line of Best Fit

Reporting Category: Statistics
Related SOL: A.16

Background Information:

- Students need to know how to find the equation of a line given two points on the line.
- Students need to know how to enter data into LISTS function of the graphing calculator.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

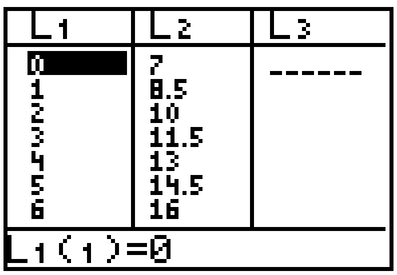
- Students should use the "eyeball" method to determine the two points they wish to use.
- Since all data is linear, no matter which two points the student chooses, all will get the same equation.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

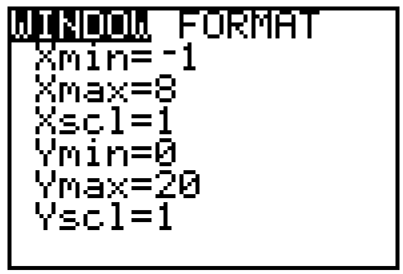
Activity Sheet: Line of Best Fit

Data 1

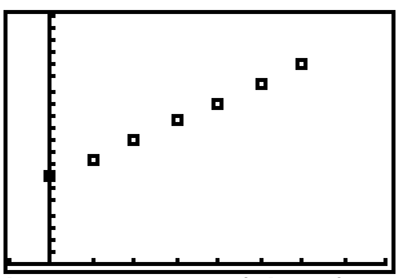
Age (in months)	Median weight For girls (in lbs.)
0	
1	
2	
3	
4	
5	
6	

Enter the data from Data 1 into L_1 and L_2.





Choose an appropriate window.



Make a STAT PLOT of the information.

Now that you can visualize the data, choose two points and determine a line of best fit through the data points.
You could use the STAT CALC function to find the line of best fit.

Follow the same procedure for each of the following Data Sets:

Data 2

Harvard Community Health Plan uses the following "rule" for the recommended weight for men.
"Give yourself 106 lbs for the first 5 feet, plus 6 lbs for every inch over 5 feet".

Data 3

Hours	Miles
0	0
1	5
2	10
3	15
4	20

Data 4

Gallons Of Gas	Dollars Spent
1	1.50
2	3.00
3	4.50
4	6.00
5	7.50

Data 5

Mean Height of Kalama Children

Age (months)	Height (cm)
18	76.1
19	77.0
20	78.1
21	78.2
22	78.8
23	79.7
24	79.9
25	81.1
26	81.2
27	81.8
28	82.8
29	83.5

Box-and-Whiskers

Reporting Category: Statistics
Related SOL: A.17

Background Information:

Students will need to know how to enter data into LISTS function of the graphing calculator.

Materials and Equipment:

- Graphing calculator and view screen
- Overhead projector
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

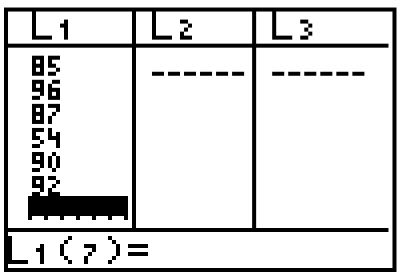
Activity Sheet: Box-and-Whiskers

Box-and-Whiskers 1:

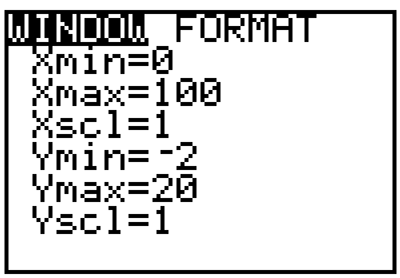
Manually, make a box and whiskers plot of the scores on this Statistics exam.

85 96 87 54 90 92

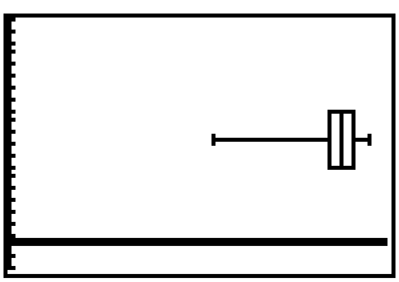
Now enter the scores into L_1



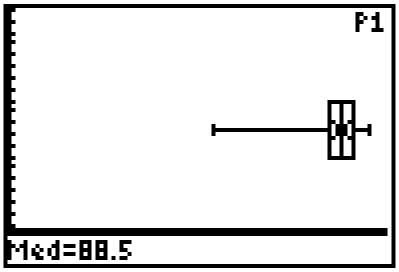
Choose an appropriate Window

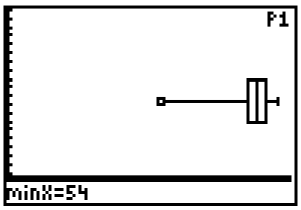


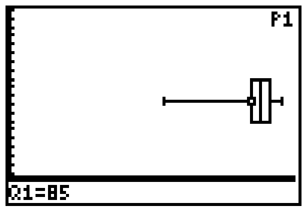
Results as follows:

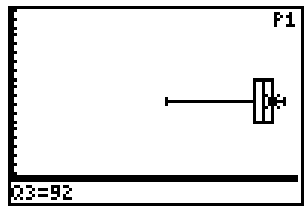


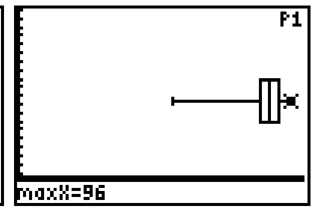
Tracing:











Try different windows. See what happens.

Box-and-Whiskers 2 (Stem-and-Leaf Plot):

The following scores were obtained by 50 students on a final exam in Statistics.
Create a Stem-and-Leaf Plot for the data.

51	46	31	35	37	51	56	51	43	48	52
33	42	37	27	57	65	36	37	55	42	43
33	49	31	46	50	57	52	35	38	47	42
58	38	47	54	39	51	68	36	48	36	47
32	51	50	44	32	36					

Using your calculator, make a box and whiskers plot of the scores. Does the Stem-and-Leaf plot help the process?
Sketch your Box-and-Whisker Plot identifying the Min, Q1, Med, Q2, and Max.

Box-and-Whiskers 3:
Scores on the first physics test are as follows:

Class 1

Student	A	B	C	D	E	F	G	H	I	J
Score	55	64	83	92	100	77	86	95	80	98

Class 2:

Student	A	B	C	D	E	F	G	H	I
Score	52	79	71	100	100	76	100	78	76

Make a box-and-whiskers plot of each set of data on the same graphics screen.

You will have to use two different LISTS and two different STAT PLOTS.

Sketch each Box-and-Whisker identifying the Min, Q1, Med, Q2, and Max of each.

Which class did better?

What is the average (mean or median?) score for each class?
(When you prompt the calculator to do 1-variable statistics, you MUST follow the prompt with the "place" you stored the statistics, i.e. $L_{???}$

Does this change your opinion about which class did better?

When statistics are "quoted", what words can be deceiving?

Can the wording affect how one perceives the overall picture of "which class did better?"

Box-and-Whiskers 4:

An experiment found a significant difference between boys and girls pertaining to their ability to identify objects held in their left hand, which are controlled by the right side of their brains, versus their right hands, which are controlled by the left side of their brains.

The test involved 20 small objects, which participants were not allowed to see. First they held 10 of the objects one by one in their left hands and guessed what they were. Then they held the other 10 objects one by one in their right hands and guessed what they were.

Correct Guesses

Women Left	Women Right	Men Left	Men Right
8	4	7	12
9	1	8	6
12	8	7	12
11	12	5	12
10	11	7	7
8	11	8	11
12	13	11	12
7	12	4	8
9	11	10	12
11	12	14	11

Make a box-and-whiskers plot that will allow you to compare the data.

Measures of Central Tendency

Reporting Category: Statistics
Related SOL: A.17

Background Information:
Students will need to know how to determine mean, median, and range.

Materials and Equipment:
Handouts

Notes to Teacher:

- This activity is very open-ended.
- You will need to ASSIGN the number of yard sale items, consequently, this activity may be used multiple times.
- It is the intent of this activity that students will need to work backwards to answer the questions.
- It is the intent of this activity that students will gain a true understanding of mean, median, and range.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: **Measures of Central Tendency**
(NOTE: Your teacher will need to determine the NUMBER of items that will be available at the yard sale.)

Scenario 1: You have been given the dubious honor of chairing the annual CMS yard sale. One of your duties is to advertise in the Free Lance Star. The ad reads:

CMS YARD SALE

Items range in price from 20 cents to $4.80.

Median price of items is $2.10.

Mean price of items is $2.10.

Explain what this means to a potential customer.

Give an example of a set of prices that fits this scenario.

Scenario 2: You have been given the dubious honor of chairing the annual CMS yard sale. One of your duties is to advertise in the Free Lance Star. The ad reads:

CMS YARD SALE

Items range in price from 20 cents to $4.80.

Median price of items is $2.10.

Mean price of items is $2.20.

Explain what this means to a potential customer.

Give an example of a set of prices that fits this scenario.

Scenario 3: You have been given the dubious honor of chairing the annual CMS yard sale. One of your duties is to advertise in the Free Lance Star. The ad reads:

CMS YARD SALE

Items range in price from 20 cents to $4.80.

Median price of items is $2.10.

Mean price of items is $1.80.

Explain what this means to a potential customer.

Give an example of a set of prices that fits this scenario.

Collecting Data and Regression Equations

Reporting Category: Statistics
Related SOL: AII.19

Background Information:

- Students will need to know families of graphs.
- Students will need to be able to enter data into lists.
- Students will need to be able to use the Regression Equation capabilities of the graphing calculator.

Materials and Equipment

- Circles cut out of poster board with 1,2,3,4,5 etc. centimeter radii.
- 1 Centimeter grid paper.
- Graphing calculator and view screen.
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- The more circles you have the better your scatterplot will look.
- This activity may be done with younger students as well. Instead of finding the regression equation for the data, students may also find the mean area as determined by the students in the class. (SOL A .18)
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Collecting Data and Regressions

Students place the circles that have been provided by the teacher and trace them onto the centimeter grid paper.

Then the students count the number of square centimeters in the area of each circle and record these results in a table.

Circle radius	# square centimeters
1	
2	
3	
4	
5	
6	

Students now place the Circle Radii in L_1 and the #square centimeters in L_2 and make a scatterplot.

Using the Regression Equation capabilities of your calculator, find the Regression Equation that you believe best fits your data and graph the curve through your data points.

Predict from your Regression Equation, the #square centimeters that a circle with a radius of 12 would cover.

Working backwards... what would be the radius of a circle that covers 450 square centimeters?

Regression Equations

Reporting Category: Statistics
Related SOL: AII.19

Background Information:

- Students will need to know families of graphs.
- Students will need to be able to enter data into LISTS function of the graphing calculator.

Materials and Equipment

- Graphing calculator and view screen.
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- This is a very interesting situation. During certain years, the regression "appears" to be linear while at other times it takes on different shapes. This could be used as a minor introduction into linearizations in calculus.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Regression Equations

Year	Marriages	Divorces
1960	1,523,000	393,000
1962	1,577,000	413,000
1964	1,725,000	450,000
1966	1,857,000	499,000
1968	2,069,258	584,000
1970	2,158,802	708,000
1972	2,282,154	845,000
1974	2,229,667	977,000
1976	2,154,807	1,083,000
1978	2,282,272	1,130,000
1980	2,406,708	1,182,000
1982	2,495,000	1,180,000
1984	2,487,000	1,155,000
1986	2,400,000	1,159,000
1988	2,389,000	1,183,000
1990	2,448,000	1,175,000
1992	2,362,000	1,215,000

Using the given data representing the number of marriages and divorces in the U.S. from 1960 to 1992,

1. Enter the year in List 1, the total number of marriages in List 2 and the total number of divorces in List 3.

2. Calculate the divorce rate and put the data in List 4.

3. Which type of regression best fits the data from 1960 to 1976?

4. If the pattern continued in this way, what would the predicted divorce rate be in 1984?

5. Which type of regression best fits the data from 1978 to 1992?

6. Based on your data, what would the predicted divorce rate be for the year 1995?

Extension:

What is a possible explanation for the different regression in the marriage and divorce rate?

Do you find anything “odd” about the data?

Matrix Multiplication

Reporting Category: Systems of Equations and Inequalities
Related SOL: AII.11

Background Information:

- Students will need to be able to set up matrices to solve problems.
- Students will need to know how to enter matrices into the graphing calculator.

Materials and Equipment

- Graphing calculator and view screen.
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- This activity may be done in conjunction with SOL A.4 (Square Patio)
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Matrix Multiplication

Jim, Kevin, Adam, and Dan are going shopping for Christmas presents. Jim wants to buy 3 CDs, 1 tape, and 8 videos. Kevin wants 6 CDs, 1 tape, and 3 videos. Adam wants 2 CDs, 7 tapes, and 1 video. Dan wants to buy 3 CDs, 2 tapes and 6 videos.

1. Set up a matrix to express the number of each item each person wants to purchase.

$$\begin{array}{cc} & \begin{array}{cccc} \text{Jim} & \text{Kevin} & \text{Adam} & \text{Dan} \end{array} \\ \begin{array}{l} \text{CDs} \\ \text{Tapes} \\ \text{Videos} \end{array} & \begin{bmatrix} & & & \\ & & & \\ & & & \end{bmatrix} \end{array}$$

Since they are wise consumers (who only have **one** car), they have researched the prices at two stores. The regular prices at Audio Attic are $18.99 for CDs, $13.99 for tapes, and $25.99 for videos. Audio Attic is having a special sale where CDs are only $14.99, tapes are $10.99, and videos are $21.99. Bargain Basement sell CDs at regular price for $16.99, tapes for $12.99, and videos for $29.99. They, too, are having a blowout sale where CDs are $13.99, tapes are a rock bottom $9.99 and videos are $26.99.

2. Set up two matrices to express the regular and sale prices at each of the stores.

$$\begin{array}{cc} & \begin{array}{ccc} \text{CDs} & \text{Tapes} & \text{Videos} \end{array} \\ \begin{array}{l} \text{Regular price} \\ \text{Sale price} \end{array} & \begin{bmatrix} & & \\ & & \end{bmatrix} \end{array} \qquad \begin{array}{cc} & \begin{array}{ccc} \text{CDs} & \text{Tapes} & \text{Videos} \end{array} \\ \begin{array}{l} \text{Regular price} \\ \text{Sale price} \end{array} & \begin{bmatrix} & & \\ & & \end{bmatrix} \end{array}$$

3. Which store should the group use to purchase their presents? How much does each person spend? (They only have **one** car so they must go to the same store.)

Extension: Suppose each person could go to the store that gave him the best price. Which store should each person go to and how much would the group save overall?

Matrices (Beginning)

Reporting Category: Systems of Equations and Inequalities
Related SOL: AII.12

Background Information:
- Students will need to know how to organize information into a matrix.
- Students will need to know how to enter matrices into the graphing calculator.

Materials and Equipment
- Graphing calculator and view screen.
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: Matrices (Beginning)

Place all the information into matrices which will help organize the data.

Gertrude, Marilda and Homer love to eat at fast food places. Generally, Gertrude orders 4 hamburgers, 4 sodas and 4 French fries; Marilda orders 6 hamburgers, 1 soda and 1 French fry, while Homer orders 2 hamburgers, 10 sodas, and 2 French fries. They shop around and find the following information for their favorite fast food places:

Wendy's charges $1.69 for hamburgers, $.79 for sodas and $.69 for French fries.
McDonald's charges $1.85 for hamburgers, $.59 for sodas, and $.75 for French fries.
Burger King charges $1.75 for hamburgers, $.65 for sodas, and $.59 for French fries.

Use the matrices to determine how much each person will spend at each fast food place.
Recommend a fast food place for each person. Explain your choices.

Solving Systems with Matrices

Reporting Category: Systems of Equations and Inequalities
Related SOL: AII.12

Background Information:
- Students will need to be able to set up systems of equations for word problems.
- Students will need to know how to enter these systems in matrix form into the graphing calculator.
- Students will need to know how to apply inverse matrix to find the solutions to a system.

Materials and Equipment
- Graphing calculator and view screen.
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:
- This activity can be done strictly by trial and error if your students have a tremendous amount of time. It can be done on a small scale with "simpler" words as an introduction or for Algebra I students.
- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: **Solving Systems with Matrices**

Use matrices to solve the following problem.

For you "Wheel " fans, why spend $250 on a vowel from Vanna White when her evil cousin Vanna Red is selling vowels for less? She sells each of the five vowels A, E, I, O, and U for a different price, but you have to pay separately for each appearance of the same vowel in a word. For example, is "A" is worth $10, each *banana* would cost $30. In the words, all consonants are free. Look at these discount prices. *Audacious* is just $260. *Equivocations* is just #340. *Inimitable* is a mere $255, while *onomatopoeia* is an unbelievable $435. Best of all, *unambiguous* is an amazing $255. Hurry, they are going fast!!

So how much does Vanna Red charge for each vowel?

Extension: Decide on new values for the vowels and make up 5 new "words" and their values to stump you friends.

Linear Programming

Reporting Category: Systems of Equations and Inequalities
Related SOL: AII.13

Background Information:

- Students will need to have been taught linear programming.
- Students will need to be able to enter linear equations into the graphing calculator and shade the graphs.

Materials and Equipment

- Graphing Calculator and View Screen
- Each student will need:
  Graphing calculator and handouts

Notes to Teacher:

- Students may work alone or in pairs on this activity.
- The time allotted for this activity varies depending on the ability level of the students.

Activity Sheet: **Linear Programming**

For each of the following:

a) write the relevant equation and constraining inequalities,
b) graph and sketch the feasibility region,
c) give the solution to the problem.

1. The Buds-R-Us Florist has to order roses and carnations for Valentine's Day. Roses cost the florist $20 per dozen and carnations cost $5 per dozen. The profit on roses is $20 per dozen and on carnations is $8 per dozen. The florist can order no more than 60 dozen flowers. How many of each kind should he order to maximize the profit ?

   Objective equation:

   Constraints:

   Solution:

2. U.N. Scrupulous, a noted businessman in town, always uses both newspaper and radio advertising each month. It is estimated that each newspaper ad reaches 8,000 people and that each radio ad reaches 15,000 people. Each newspaper ad costs $50 and each radio ad cost $100. The business can spend no more than $1000 for advertising per month. The newspaper requires at least 4 ads be purchased each month and the radio requires that at least 5 ads be purchased each month. What combination of newspaper and radio ads should old "Scrupe" purchase in order to reach the maximum number of people?

   Objective equation:

   Constraints:

   Solution:

3. The campus store sells stadium cushions and caps. The cushions cost $1.90; the caps cost $2.25. They sell the cushions for $5.00 and the caps for $6.00. They can obtain no more than 100 cushions and 75 caps per week. To meet demands, they have to sell a total of at least 120 of the two items together. They cannot package more that 150 per week. How many of each should they sell to maximize profit?

Objective equation:

Constraints:

Solution: